MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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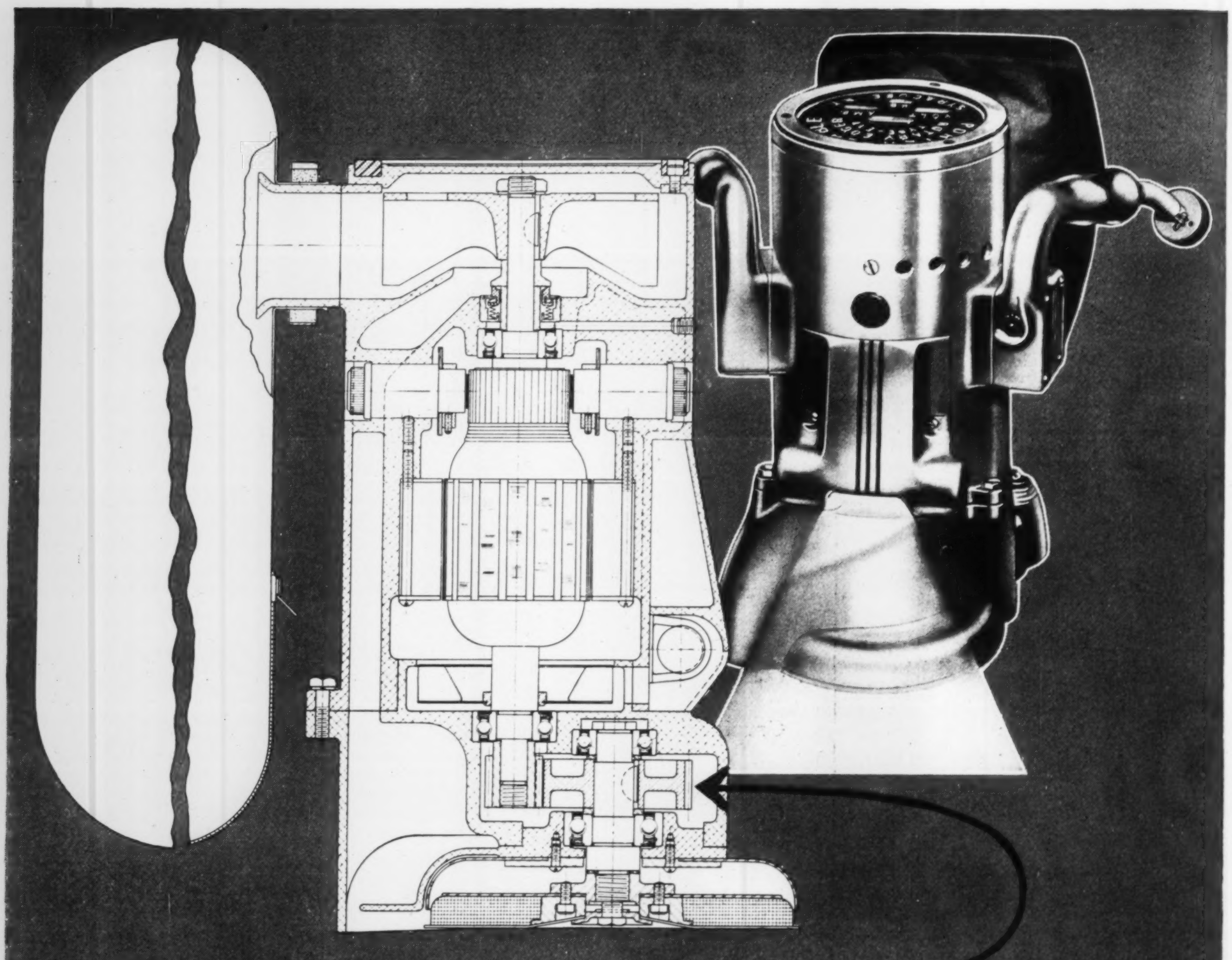

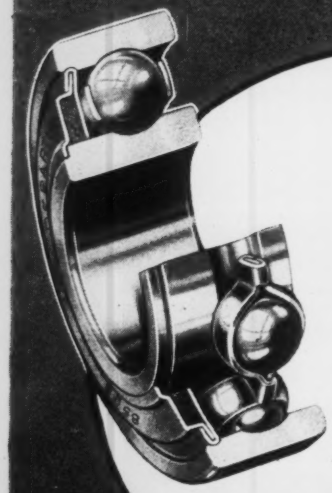

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TOPICS

MACHINE progress conquers another arduous chore that besets most of us from childhood to old age. Brushing one's teeth now becomes something of a recreation since a motor-driven toothbrush has been invented and placed on the market. Mothers should no longer have to cajole their children into learning the toothbrush habit and father will look forward with unmixed pleasure to his morning ablutions with mechanized razor and toothbrush. It is really not an expensive proposition either, for individual brushes may be fitted to the motorized holder for each member of the family.

* * *

Because oil is a poor cooling medium, having a high viscosity and low thermal conductivity, engineers have been confronted with a heat dissipation problem in the bearings of diesel engines. Operating at higher temperatures and with greater bearing pressures than the conventional gas engine, diesels are particularly prone to bearing failure from excess heat. One method to dissipate this heat which has been successfully tried experimentally is drilling the crankshaft from end to end and circulating water through it. Water enters at one end and leaves by the other with no chance of its mixing with the oil in the crankcase. It is cooled in the radiator. Expense of drilling the crankshaft is considerable but bringing water directly to the source of heat is apparently the most effective method of dissipating it.

* * *

A method of inspecting machine parts for hidden flaws without injuring them has been developed by General Electric Co. Principle is that substantial change in the constitution or state of magnetizable material will be reflected in its magnetic characteristics. In testing, a constant magnetic field is produced which penetrates the entire thickness of a small area of the part being inspected. The part is slowly revolved so as to change the section within the field until the whole has been magnetically explored. Imperfections such as voids or nonhomogeneous areas in the interior betray themselves by producing disturbances in the magnetic field at the surface of the part. Magnetic search coils are mounted close to the external surface. Any sudden change in the magnetic linkage created by a discontinuity in the metal of the part produces a corresponding sudden electric voltage in the external measuring circuit. As a result the imperfection is detected.

* * *

In 1919 two San Francisco automobile mechanics, Cantrell and Miller, became dissatisfied with the way grease leaked from the rear axle of the old model T Ford and decided to design their own grease seal, according to the bulletin of Arthur D. Little Inc. Ten years later each retired with a comfortable fortune after having launched the modern seal used on rotating shafts which consists primarily of a sealing ring of leather or synthetic compound held closely to the shaft by an arrangement of metal annular rings or springs. To date about 50,000,000 of the seals have been made, automobiles alone using several million in a normal year. A little effort at the right times goes a long way! Probably thousands of mechanics had been irked by leaking Ford grease seals, but only these two took the initiative to correct the trouble.

* * *

Where appearance must be maintained up to 1400 degrees Fahr. Monel metal with an ebony finish has been developed. The material is identical with standard Monel except that a lustrous "blue-black" finish is imparted in a specialized oxidizing operation. Element pans, reflectors and deflectors in electric heating units have been the source of complaints because the materials from which they were made invariably suffer heat discoloration or stain and rust. This new ebonized metal possesses complete rust immunity and diversified resistance to corrosion in addition to its ability to resist discoloration from relatively high temperatures.

* * *

Cellulose plastic coating which can be applied either by dipping or spraying on metal, wood and rubber has been developed by a Detroit company. The coating may be applied to practically all types of metal surfaces and is said to permit a wide variation in color. Various shades are obtained by pigmenting the coating material to any degree. The coating process is being used chiefly on automobile hardware at the present time but is suitable for all kinds of metal parts.

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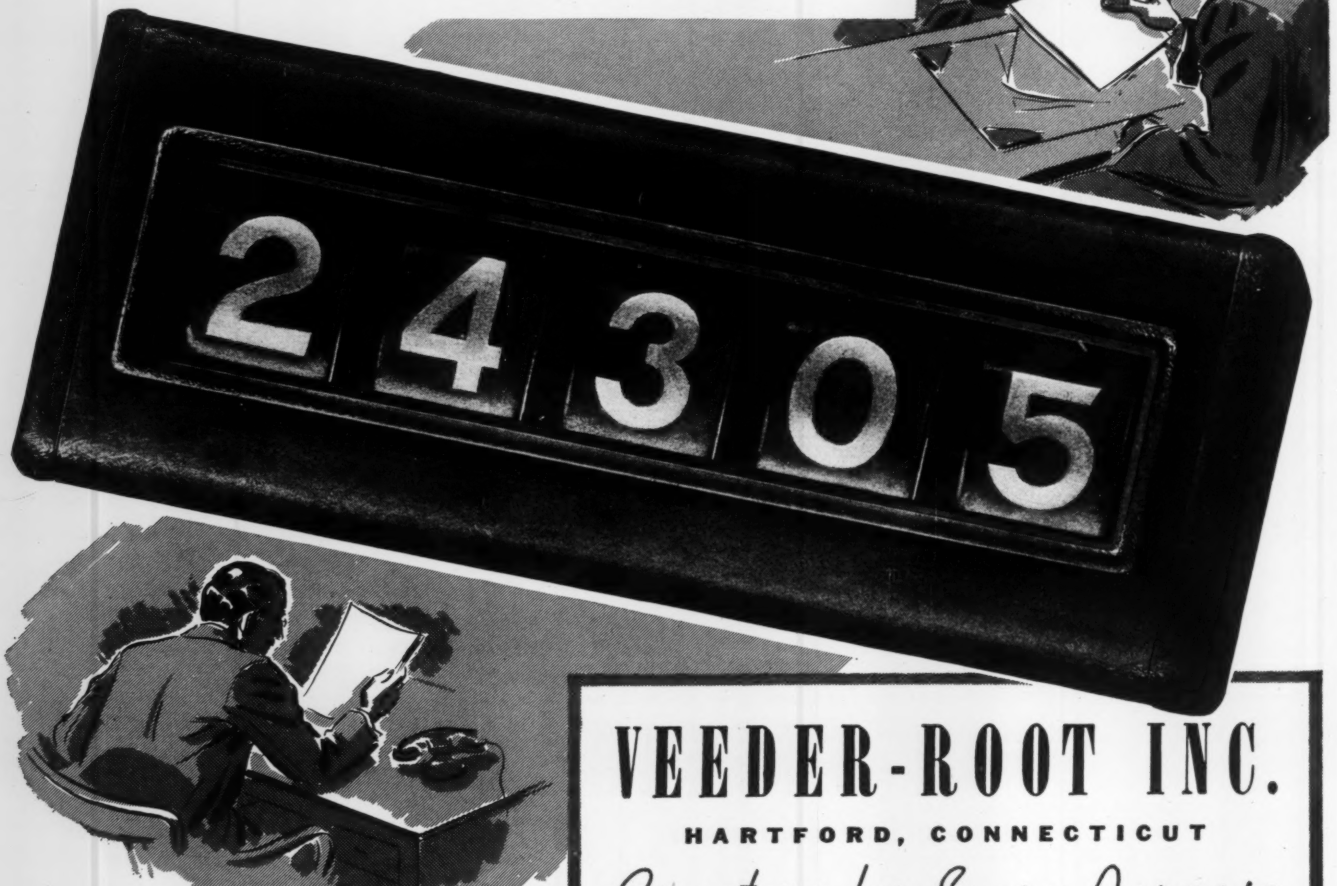

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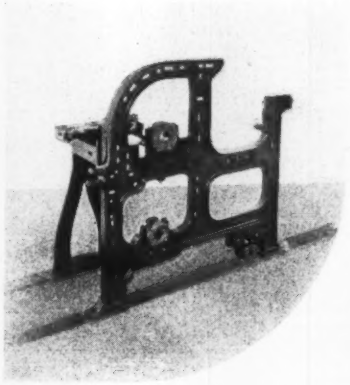
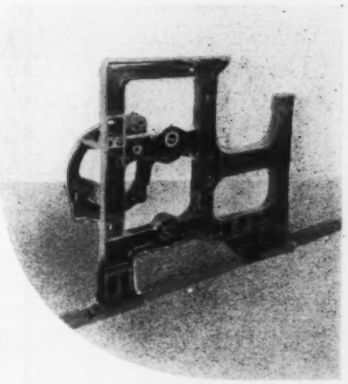


By Albert Palmer

Crompton & Knowles Loom Works



Textile Machines Show Influence of Modern Design

TO reduce wear to a minimum, the efforts of the textile machinery manufacturers have been directed toward improvements in design, improvements in finish, and improvements in the materials that are used. The results that have been obtained can be attributed to the joint effort of the engineering and metallurgical departments of the several manufacturers in co-operation with the manufacturing departments of these machine building concerns. Mechanical changes have been made in the interest of reducing shock loads, increasing bearing areas, providing more accurate assemblies, improving the running fits of parts, providing locking devices to eliminate maladjustment resulting from vibration, and making provisions for better lubrication. The last-named item includes the proper

Fig. 1 — Above, left — Loomside of older design on which bearing boxes and other separate details were hand-fitted to the rough casting

Fig. 2—Above, right—New style loomside having bearings supported in accurately machined seats and with machined pads for other parts

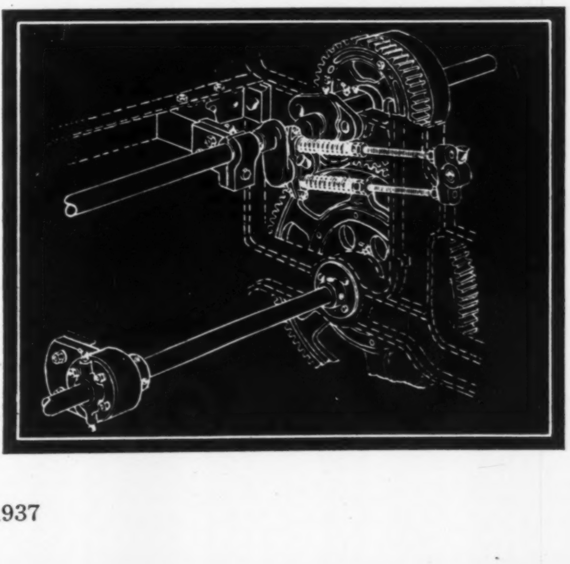


Fig. 3—Left—This section of a modern silk loom shows on the lower shaft a typical roller bearing assembly, while attached to the crank is one of the improved shock absorbing connectors

MR. PALMER'S article is based on his contribution to the "Symposium on Wear of Metals", sponsored recently by the Philadelphia district committee, American Society for Testing Materials. Credit is due the Society for its permission for—and cooperation toward—this presentation

placing of oil grooves and lubrication fittings, as well as the selection of suitable lubricants.

The trend of modern design is best illustrated by taking a machine of 1937 and comparing it with one that is typical of those that were manufactured a few years ago by the more progressive manufacturers. The new loom is heavier than the old. It weighs approximately 12 per cent more. As in the case of the old machine, it is made primarily of cast iron and steel. However, the amount of steel in it is nearly two and a half times the amount of steel in the old loom. The amount of cast iron, on the other hand, is slightly over 9 per cent less than the amount of cast iron in the old machine.

Many Points of Wear Exist

In order that the trends in textile machine design may be indicated more clearly, the complexity of the two cases should be explained. The new machine is composed of 1166 separate pieces, some of which are assembled together in a permanent fashion to form a machine unit or part. There are 910 such units in this modern machine. Similarly, the old machine is composed of 1043 pieces forming 917 units. Naturally, all the units do not move. It is a fair statement, however, to say that two-thirds, or about 600 points of wear exist.

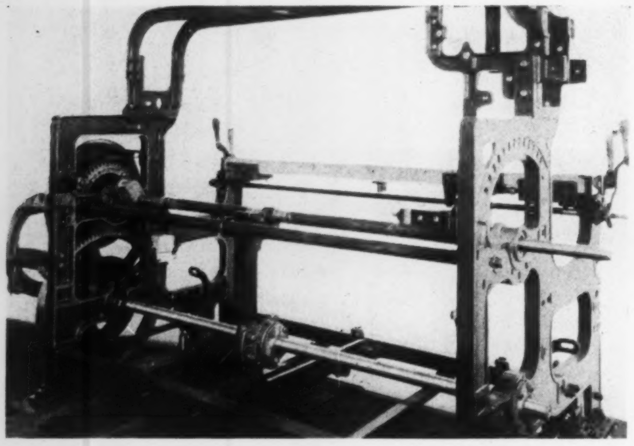


Fig. 4—Improved loom frame comes from assembly fixture perfectly aligned and with accurate bearings

A condition fundamental to the reduction of wear in machine parts is the provision of an accurately made and rigid basic structure. To show the advance in this direction, comparative views of two silk loomsides with the main bearings in place are presented in *Figs.* 1 and 2. Notice that in the new loomside machined pads are provided for all parts that are attached to it and that the bearings are supported in machined seats which are bored and reamed in the loomside. The old loomside was a rough casting to which the bearing boxes were fitted by hand. It should be noticed also that the motor supporting frame in the new design is carried entirely by the loomside and is not dependent upon a support to the floor. This arrangement produces a rigid assembly that minimizes vibration.

Fig. 4 shows a modern silk loom frame as it leaves the assembly fixture. The machined loomsides and machined structural steel lengthwise members make a rigid assembly which is perfectly lined and squared. The shafting, though closely fitted, turns freely because the bearings are in perfect alignment -- something that was not possible in the old machine.

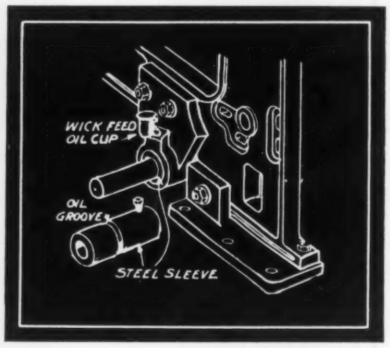


Fig. 5 — Rocker shaft bearing as redesigned to reduce unit pressure and to insure effective lubrication

An up-to-date machine for fine, high-quality goods must have shafting that turns freely with clearances that range from 0.0015 to 0.005-inch, depending upon the size of the shaft. Such accuracy can be maintained only by increased bearing areas, by improved finish, and by better facilities for lubrication. In modern looms there are more and larger bearings than in looms of old design. The bearings are closely machined, the shafting is centerless ground, and oil grooves, which are located properly on the low-pressure side of the bearings, are supplied with oil from wick-feed oil cups.

The treatment of the so-called rocker shaft is a case in point. Formerly this shaft was a piece of cold-drawn steel, 1 5/32-inch in diameter oscillating in a cast iron pipe box. It had only an open oil hole placed on the top of the bearing for lubrication purposes. This arrangement was not satisfactory because the oil could not reach the high-pressure side of the bearing at the bottom. The shaft merely oscillated through an angle of approximately 10 degrees and for that reason, could not maintain an oil film such as would be present with a rotating shaft.

In the latest cotton looms the particular bearing under discussion is treated in a different manner. A shaft 1 3/16-inch in diameter is used and a steel bushing 2 inches in diameter is fastened by a set screw to the shaft. The bushing then oscillates with the shaft in a pipe box. Along the top of the box is a straight oil groove connecting with a wick feed oil cup. This oil groove intersects another which is around the circumference of the bushing. The effect of this combination, shown in *Fig.* 5, is to reduce the bearing pressure per square inch of projected area to 58 per cent of its former amount, to introduce a method of lubrication by which the oil can be conducted to the bottom of the bearing, and to provide a more ready means for repairing the bearing.

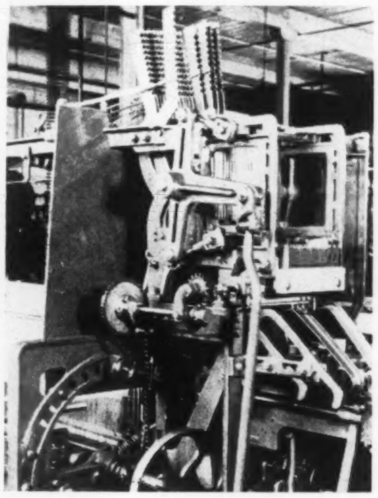


Fig. 6—Undue wear of dobby mechanism used on looms set up for weaving fancy fabrics, is eliminated by parts of better material with smoother and more generous bearing surfaces

The original roller bearing application on looms consisted of a roller assembly which ran directly on the shaft and on a split outer race which was confined in the bearing housing. The first applications were made on cold-drawn shafting, the Brinell hardness of which was approximately 143. The split outer race had a Brinell hardness ranging from 201 to 238, or a Rockwell hardness, "B" scale, of 95 to 102. This combination was not very successful because the rollers wore the shaft; consequently, the Brinell hardness of the shaft itself was made approximately 225 to 250 Brinell.

Although the increased hardness of the shaft helped somewhat, the roller bearing application left something to be desired; hence with the co-operation of the bearing manufacturer, a bearing with a solid inner and outer race was installed. These solid races are made of S. A. E. No. 1010 or 1015 steel, carburized to have a carbon content at the bearing surface of 0.90 to 1.00 per cent. The case depth on these races is about 0.070-inch after grinding.

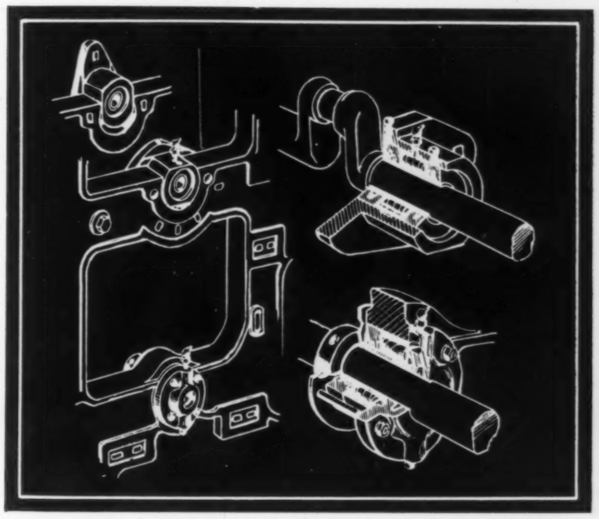


Fig. 7—Details showing successful methods of adapting roller bearings to vital points in a loom

In this construction, the inner race is held on the shaft either by a drive fit or by a collar provided with a tongue which fits into a notch in the inner race. The outer race is a slip fit in the bearing housing in which it is kept from turning by the clamping action of the retainers. The shaft itself is a cold-drawn shaft of 0.10 to 0.20 per cent carbon steel of approximately 143 Brinell hardness, centerless ground to the proper dimensions for the inner race.

Fig. 3 shows a diagrammatic sketch of a typical roller bearing installation on a silk loom. *Fig.* 7 gives a cross-section view of the details.

Threads Are Interwoven

In weaving machinery one of the essential operations is to beat into place the transverse or filling threads of the cloth which are interwoven with the longitudinal or warp threads. This operation is performed by means of a comb-like arrangement, called the reed, which is supported in a reciprocating member, called the lay, which, in turn, is driven through a pair of crank connectors by the crankshaft of the loom. *Fig.* 3 shows the crankshaft and a crank connector.

Originally, in the old looms, a very crude form of connector was used. This consisted of a wooden member with steel straps that went around the crank wrist at one end and the connector pin at the other.

The original attempt to better the connector consisted of a solid member in which split bronze bushings were held in place by a steel strap at each end. The rigidity of this design soon resulted in the introduction of the shock-absorbing springs as shown. In that connection the wrist end of the connector was redesigned so that it consisted of a two-piece cast iron box in which the halves of a bronze bushing were held. These halves, made with an undercut back, were placed in the foundry mold and were locked in place by the iron that was poured around them.

This arrangement worked fairly well, but showed a considerable amount of wear, primarily because of the impact load which developed when there was a small amount of play in the bearing. Most of this difficulty was attributable to the failure of the iron to back up the bronze bushings as solidly as it should have; consequently a change was made to solid cast bronze parts for each half of the bearing.

In determining the specifications of the bronze to be used, tests were run on a specially constructed machine over a period of 730 hours of continuous operation. For each type of bronze two tests were run, one using grease and the other oil for a lubricant. These experiments indicated a considerable difference between the various bronzes and an appreciable difference between the methods of lubrication. A semiplastic bronze with a fairly high lead content was found to be the most desirable. In 730 hours of operation the wear of the plastic bronze was approximately one-fourth of the wear of an ordinary brass casting. An interesting point to notice in passing is that the wear with the grease lubrication of this part was from 4 to 10 times the wear using the same material lubricated with oil.

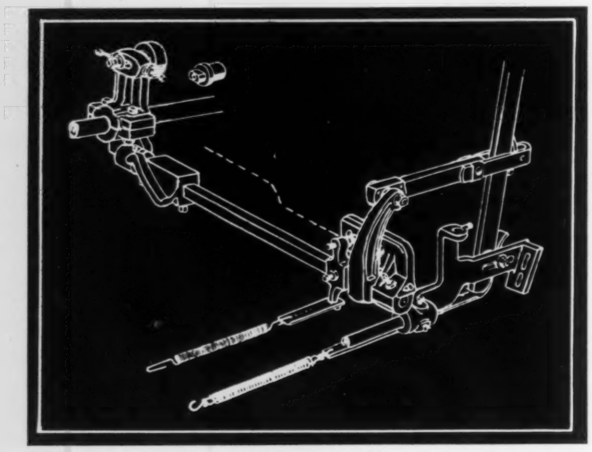


Fig. 8—Diagram of "picking motion" by which the shuttle is driven across the loom at high speed

The other end of this same crank connector, *Fig.* 3, presented a problem of a slightly different nature. Here there is oscillation on a pin with a bearing surface which is not very generous because of space limitations. Various types of bronze bushings were tried. The original metal had a 7 per cent lead content, but was found to be unsatisfactory because as soon as any wear developed in the bearing, the reciprocating action of the machine set up an impact load which very quickly changed the hole from one of round to one of oval shape. Accordingly, the amount of lead was decreased in favor of more copper and more tin to produce a metal with a monotron hardness ranging from 28 to 32 kg. instead of one having a monotron hardness of around 10 kg. The change enables the bearing to stand up under its normal running load which is in the neighborhood of 200 pounds per square inch of projected area as well as under a shock load of an indeterminate amount which occurs when the machine comes to a sudden stop through the failure of the shuttle to traverse the loom properly.

Slow Speed but High Load

In looms there is a mechanism known as a "dobby". This piece of equipment is employed in the weaving of fancy fabrics such as dress goods, shirting, curtains, handkerchiefs, and other fabrics of cotton and rayon. It operates at a relatively slow speed but is subject to appreciable loads, especially under the conditions of modern rayon weaving.

Fig. 6 shows the dobby installed on a loom. The hooks and the jack backs have presented a serious problem. Years ago they both were made of malleable iron. Later the hooks were made of drop forgings and the jack backs of pressed steel. These parts were not heat treated.

Though substantial from the standpoint of strength, they wore badly at various points. The hooks were cut by the chilled knife and wore on the needles because of sliding. Similarly the jack backs wore for the same reason on the girt. These troubles were accentuated by the difficulty of lubricating the parts, not only because they were unable to retain the lubricant, but also because the mills minimized lubrication to prevent misindications in the weave such as occur when the inevitable mixture of oil, grease, and lint prevents the parts from working freely.

Although space limitations prevented radical changes in design, the wearing surfaces were increased. The hooks, still drop forged, are now heat treated. The jack backs, now made of heat-treated drop forgings, are machined and polished where formerly they retained the scoring and rough edges that resulted from the punching operations on the pressed steel parts.

The girt formerly was a rough gray iron casting. Because of cost considerations, it could not be machined. Drop forgings also were out of the question because of the large number of lengths that were necessary for dobbies of different sizes. The

(*Continued on Page* 90)

Scanning THE FIELD FOR Ideas

IN CHICAGO'S downtown loop area where annually the dirt deposited out of the atmosphere averages a thousand tons per square mile, electrical engineers are producing the cleanest air in the world. Before being distributed through the lower floors of the Field building, air is cleaned by an electrostatic process developed by the Westinghouse research laboratories. This removes up to 99 per cent, by weight, of all particles in the atmosphere, even those which are as small as four-millionths of an inch in diameter.

Impurities are taken from the air by charging all particles electrically and then pulling them out as they pass through an electrostatic field, in a manner similar to that by which a magnet attracts iron filings.

The air is first bombarded by ions—minute electrical charges—emitted by wires as fine as human hair and which carry a charge of 12,000 volts. The ions attach themselves to the floating particles thus giving them an electrical charge. Next the treated air is drawn through a series of cells consisting of alternately spaced high-potential and grounded plates. By charging the high-potential plates at 5000 volts an electrical field is established. As the treated air passes through these cells, the charged particles adhere to the plates. The clean air then passes through ducts to areas being served.

In the Field building, first to have an electrostatic installation, the eighteen units are capable of cleaning 272,000 cubic feet of air each minute. This installation is depicted in *Fig.* 1, the left hand view being the inlet and that at the right the outlet. In a year's time, it is estimated, the apparatus will have collected approximately 600 bushels of impurities, 90 per cent of which will consist of particles one-hundredth the diameter of human hair. By weight, the collection will consist of one-third ash; another third fixed carbon, soot lampblack and other derivatives; and the remaining third volatile matter such as oils and greases. Sulphur, bacteria, pollon in season, and other substances found in suspension in the atmosphere of any city, are also deposited on the plates.

Ball Joint Has Diaphragm Seal

AN INGENIOUS improvement to the familiar ball joint has recently been patented by the Davis Regulator Co. While originally developed in connection with regulators as a transmission unit for float boxes and lever-operated control valves involving vertical

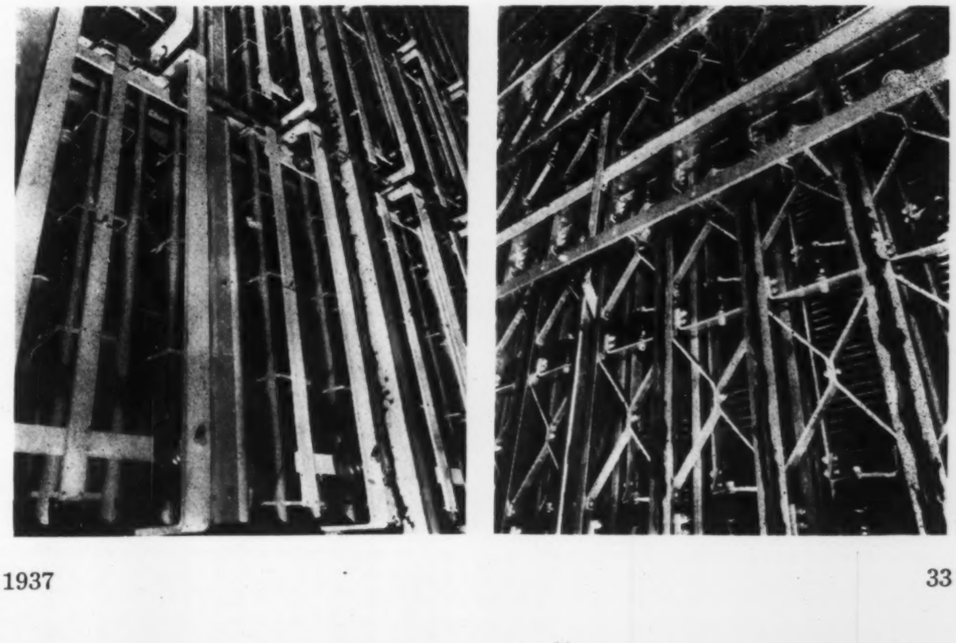


Fig. 1—Apparatus for electrostatic cleaning of air distributed to lower floors of Field building, Chicago. This installation, of which inlet is shown at left and outlet at right, handles 272,000 cubic feet of air per minute and will precipitate as much as 600 bushels of impurities in a year

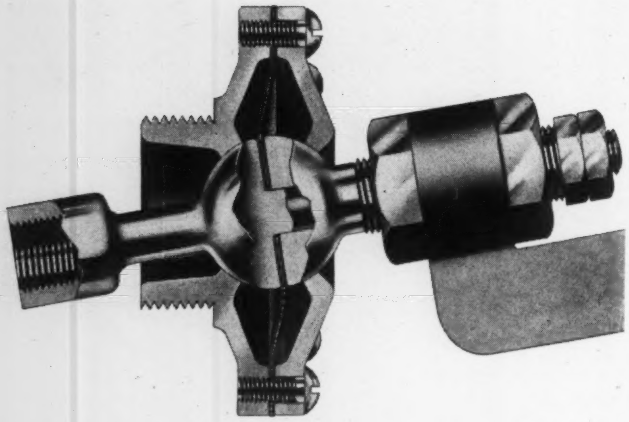


Fig. 2—Oilproof flexible disk eliminates possibility of leakage around rocking ball joint

motion only, the unit has possibilities for transmitting compound motions. For instance, it could be used effectively for rotating a mechanism confined within a sealed vessel.

As will be noted in the illustration, *Fig.* 2, positive sealing is effected by means of a flexible diaphragm clamped at its outer edge between the flanges of the casing and at its center between the hemispheres of a split ball. The method by which these hemispheres are aligned and drawn together by the threaded stem of the inner one which extends through the hollow stem of the outer, is clearly shown. The annular space around the ball is packed with graphite grease which lubricates the joint over a very long period.

By using chloroprene synthetic material in conjunction with strong fabric for the center diaphragm, even the severe temperature, pressure and corrosive conditions involved in oil refining equipment have been met successfully by this leak-proof ball joint unit.

Floating Connection for Helix

WHEN a helical coil is used in a thermometer or other type of indicating and recording instrument as the element for actuating the pointer or pen arm, it is important that the designer shall take into account the action of the helix as its coils expand and contract.

If an attempt be made to transmit the angular rotation of the helix to the spindle of the indicator through a rigid connection such as is shown by the upper row of diagrams in *Fig.* 3, several undesirable things happen, all of which are made clear by the diagrams just mentioned. As the coils expand, the end of the helix moves from Position *A* to Position *B* (see top view at left of cut). The effect of this is to crowd the spindle against one side of its bearing in the face plate.

At the same time the height of the helix increases and the effect of that movement on the rigidly anchored spindle is to force its shoulder against the inside of the face plate. The two elevation views at the right of the cut demonstrate that effect and its result.

In seeking to overcome these difficulties, the Mason-Neilan Regulator Co. has developed what is called a "floating coil clamp," on which a patent has been obtained. The nature of this improvement, and its action, are revealed by the three diagrams at the bottom of *Fig.* 3.

It will be noted that in this new system the connection between helix and spindle—instead of being rigid—is free both cross-wise and up-and-down. The body of the spindle is in the nature of a flat reed which is an accurate sliding fit in a slotted radial link anchored to the free end of the helix. Although the coils of the helix expand laterally and the whole helix changes in length just as in the prior case, no unnatural forces are imposed upon the spindle. The link slides upon the flat body both lengthwise and crosswise without affecting it—impressing upon the spindle only the angular motion through which the recording is made.

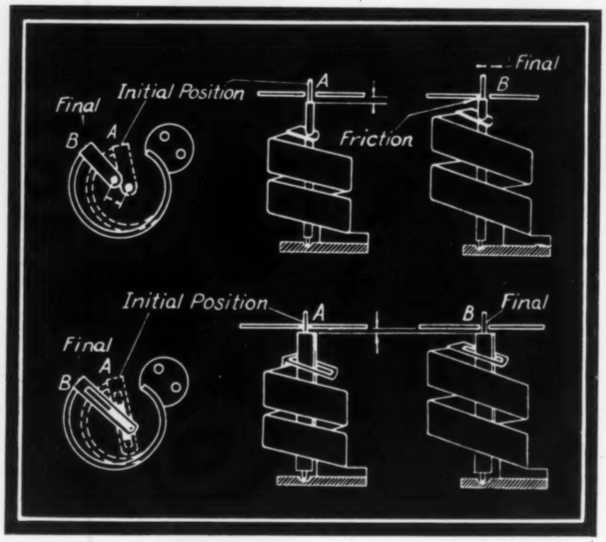


Fig. 3—Effect of an opening helix, lower diagrams showing nonbinding connection for instruments

Flexible Boot Prevents Leakage

A GLAND that "breathes," but which at the same time seals perfectly, is an important element in one of the new diesel engines developed by the Cummins Engine Co. This gland, a cross section of which is shown in *Fig.* 4, is used to seal the connection between fuel pump and governor.

On one side it is exposed to fuel oil and on the other side to lubricating oil, the temperature of which may vary from zero or below zero to about 250 degrees Fahr. As can be seen from the drawing, this "boot," as it is called permits of longitudinal expansion and contraction, making it possible to effect a perfect seal at each end, and still allow for changes occasioned by temperature or minor shifting in the position of the parts.

The material used for this part is neoprene, a chloroprene rubber manufactured by E. I. du Pont de Nemours & Co. which resembles rubber in elasticity, strength, resilience and abrasion resistance yet is superior to rubber in that it resists the deteriorating effects of oils, chemicals, heat, ozone and aging.

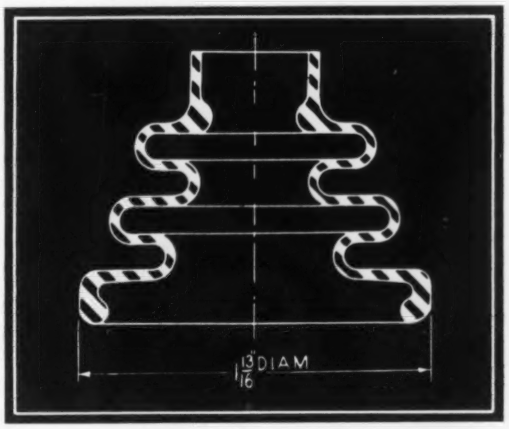


Fig. 4—Elastic boot seals gland between fuel and lubricating oil chambers

Cams Operate Helical Plungers

AS WILL be seen from *Fig.* 5, at the right, the new Timken solid injection diesel fuel pump is of cam operated helical plunger type. Its metering is adjusted at factory and is sealed.

At the lowest position of the plunger the cylinder receives a charge of oil from the feed line, which is kept filled by a special feed pump connected to the fuel tank. Delivery of the fuel to the engine starts as soon as the piston covers the inlet port and ends when the upper helical edge of the annular groove in the piston opens the overflow or by-pass port on the opposite side of the pump cylinder wall, releasing the pressure to the discharge line.

A feature of these pumps is that they are driven by constant velocity cams. Thus delivery of fuel to the combustion chamber is constantly maintained at a speed adapted to rate of combustion, thereby insuring efficiency and fuel economy. Deceleration portion of the motion comes late in the stroke, thus permitting use of a lighter spring, which reduces spring load between tappet and cam.

For adjusting the pistons to vary amount of fuel delivered, a rack rod extends horizontally along the rear face of the pump, meshing with precision gears on the upper ends of the driving sleeves. The driving sleeve for each piston may thus be rotated on the barrel of the pump. This upper sleeve is tongue and groove connected with the lower sleeve, which fits on the piston. As the upper sleeve is rotated on the barrel, the lower sleeve rotates the piston, thereby changing position of helix with respect to relief port.

Surrounding these sleeves are light helical springs that serve to retract the pistons and hold the driving sleeves in position. The tappet cup is made of a new type graphitic steel developed by Timken Steel and Tube division.

Seek "Creep Control" for Steel

MANUFACTURE of steel products which undergo tension at high temperatures will leap a bothersome hurdle if United States Steel Corporation scientists successfully control "creep." This stretching of metals requires 1142 years to cover an inch, or—translated into longer distances—negotiates a foot in 13,704 years.

Results of tests so far, as disclosed in a scientific paper presented recently before the American Society for Metals at Atlantic City, indicate that special methods of heat treatment may make it possible to improve the natural resistance of certain steels to "creep." The problem is of importance in manufacture of machine parts which are subjected to tension at high temperatures, such as the blades in steam turbines and locomotive pistons.

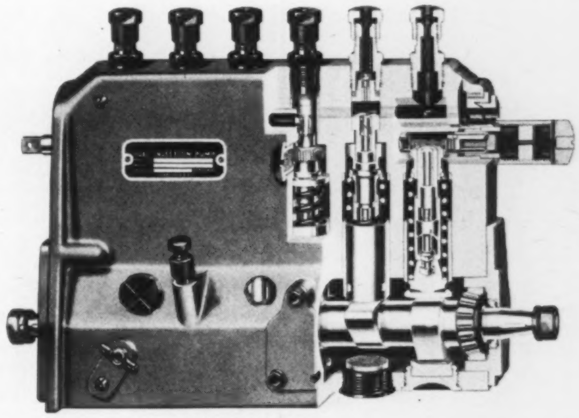


Fig. 5—By turning piston in cylinder, point at which overflow is uncovered is changed

Specimens of different kinds of steel half an inch in diameter and two inches long have been undergoing long-extended and exacting "creep" tests in the research laboratory of the United States Steel Corp. at Kearny, N. J. Placed under tension at temperatures of 1100 degrees Fahr. and held that way for a period of 3000 hours, or about four and a half months, the specimens are measured for "creep" twice a week, a powerful microscope being required to make these readings.

Graphical Method of Finding Section Elements Aids Designers

By Raymond E. Orton
Acme Steel Company

ALTHOUGH the majority of sections encountered in stress analysis are simple and their elements may be calculated directly by formulas or at least by simple mathematical integration, in many important cases formulas are not available and the integration is difficult and tedious, if not altogether impossible. Often the boundary curve of the section may not even be mathematically known. Recourse is generally taken in such cases to a method of approximate integration by the dividing of the section into small parts and summing the effect of these parts about the reference axis. Such a method is long and tiresome and subject to errors. Graphical determination of the elements is a method readily applied and of close approximation which will be of distinct advantage to the designer when calculating stresses of machine structures.

It is presumed that the reader has knowledge of the method of graphical integration of a given curve by the laying out of sections of the integral curve with slopes equal to the corresponding ordinates of the differential curve. The method is described in the book *Graphics,* by R. H. Smith.*

Consider any particular section, for example that shown in *Fig.* 1. It is desired to determine the area and other elements with reference to the Y axis. The section is bounded by the curve $y = f(x)$, the X axis, and the ordinates at $x = c$ and $x = d$. The mathematical expression for $f(x)$ is not necessarily known, nor need it be determined. The usual requirement of a curve that is single valued along the X axis (i.e., for any value of x there must be one, and only one, value of y), must be met. The curve, moreover, should be entirely above the X axis to avoid the concept of a negative value to our boundary curve. If the given section does not have a single valued boundary curve it must be divided up into parts, such that any part is single valued, then each part handled separately and the results summed. It is not necessary, however, that the requirement for mathematical integration of a continuous curve be met.

The area, A, of this section is given by the expression

$$A = \int_c^d dA$$

Substituting $dA = ydx$ we have,

$$A = \int_c^d ydx = \int_c^d f(x)\,dx$$

This may be integrated by the previously mentioned graphical method which will give us a continuous curve, the ordinate of which will, at any point, equal to some scale the area under the curve $y = f(x)$ between c and the point on the X axis at which the ordinate is taken. The ordinate at $x = d$ will give the area of the entire section.

The centroid of the section may be determined from $x = M_s/A$ where M_s is the "Statical Moment" of the area about the Y axis and x is the distance of the centroid from the Y axis. Now

$$M_s = \int_c^d xdA = \int_c^d x\,[ydx] = \int_c^d x\,[f(x)]\,dx$$

If we let $y_3 = x\,[f(x)]$ then

$$M_s = \int_c^d y_3\,dx$$

If we had the curve represented by $y_3 = x\,[f(x)]$ we could integrate it as we did to obtain the area and thus obtain M_s. This curve may be obtained by multiplying our first curve, $f(x)$, by x. For example, at any point $x = a$ (*Fig.* 2), for which $y = b$, we have $y_3 = ab$. We could, if we wished, take successive points along the X axis, multiply the values of x by the corresponding values of y and thereby obtain the corresponding values of y_3 which could then be plotted to obtain the desired curve. We will do just this by a graphical construction.

Consider the superimposed similar triangles shown in *Fig.* 3 in which p is any arbitrary length, a is the value of x shown in *Fig.* 2, b is the value of y. Now $u/a = b/p$; therefore $u = ab/p$ or u equals our desired ordinate multiplied by the quantity $(1/p)$. This construction could be made at successive points along the X axis keeping p constant. We would then ob-

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*An article discussing this method appeared in the February, 1934, issue of MACHINE DESIGN, "High Speeds, Increased Loads Complicate Shaft Design," by Edward K. Hankin.

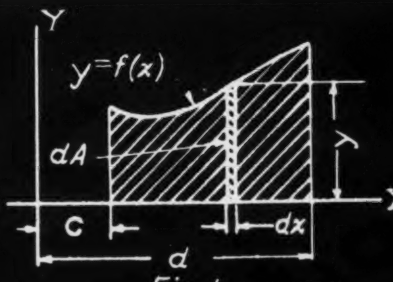

Y
y=f(x)
dA
y
X
c
dx
d

Fig. 1

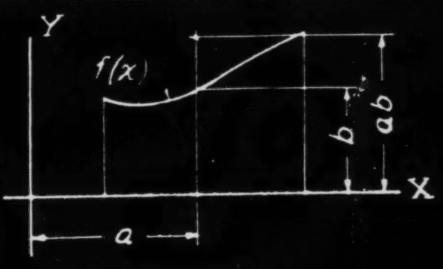


Fig. 2

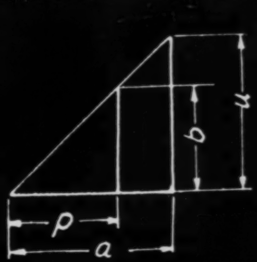


Fig. 3

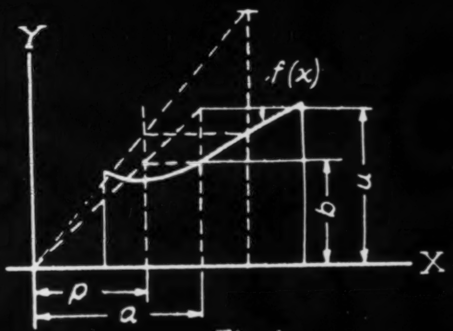


Fig. 4

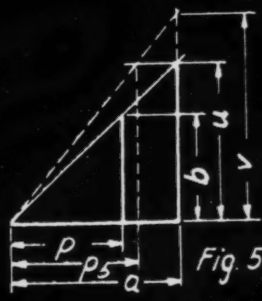


Fig. 5

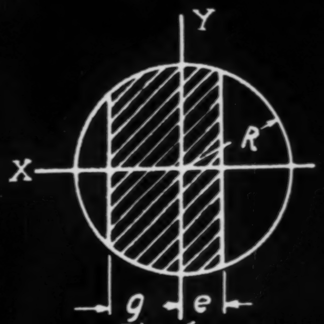


Fig. 6

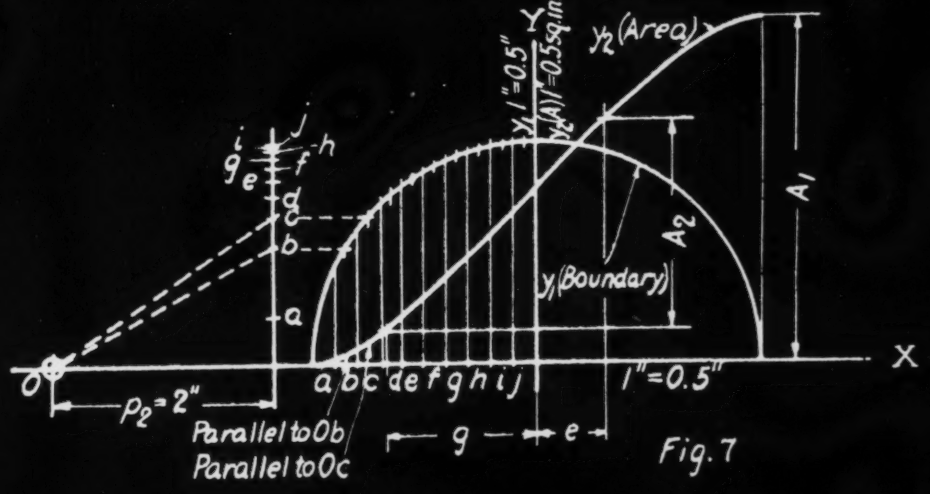

y2(Area)
Y
y1 1"=0.5"
y2(A) 1"=0.5 sq.in.
A1
A2
y1(Boundary)
i
j
h
g
f
e
d
c
b
a
O
P2=2"
a b c d e f g h i j
1"=0.5"
X
Parallel to Ob
Parallel to Oc
g
e

Fig. 7

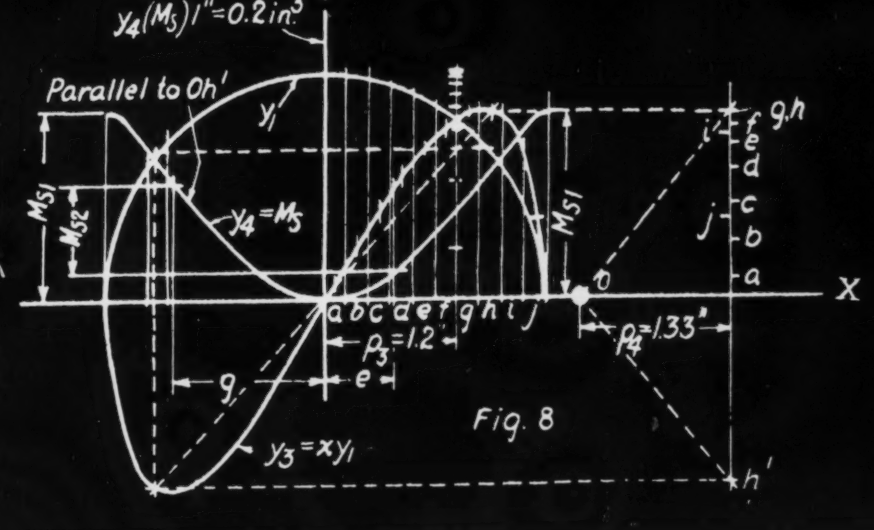

Y
y4(Ms) 1"=0.2 in.3
Parallel to Oh'
y1
Ms1
Ms2
y4=Ms
Ms1
g,h
i'
f
e
d
c
j
b
a
O
X
a b c d e f g h i j
P3=1.2"
P4=1.33"
g
e
y3=xy1
h'

Fig. 8

tain a curve equal to $(1/p)\ y_3$; or we may say, we have our desired curve but to some other scale. The determination of this scale may be made as follows:

Let m be the scale on the X axis, i.e. x is laid out to scale 1 inch$=m$ units, and n the scale of Y. (Note: the n scale will usually be the same as the m). Referring again to *Fig.* 3, the small triangle base has been laid out p inches long, the base of the large triangle will measure (a/m) inches, the height of the small triangle will be equal to (b/n) inches. Therefore the *length* of u will be $[(a/m)\times(b/n)]/p$ inches $=ab/pmn$ inches, and this number of inches is to represent ab units. Therefore, one inch will equal $[ab]\div[ab/pmn]$ units$=pmn$ units. Therefore, the scale of our derived curve $y_3=x[f(x)]$ is $pmn=k$ units.

The above construction could be made for every point desired on the new curve, constructing the triangles on the fixed base p, and transferring the values of u back to the diagram. The process can be greatly simplified, however, by the composition shown in *Fig.* 4, where the solid lines show the original curve and the dotted lines the construction to obtain two points on the derived curve. The similar triangles are laid out with their bases on the X axis and their vertices at the origin. Then any point chosen on the X axis will determine the base of the second triangle for that value of x. It will only be necessary to project the value of y, at that value of x, to the perpendicular at the end of p to complete the legs of the two triangles. Then a straight edge laid through the origin and across the top of the p triangle will form the hypotenuses and the value of y_3 can be marked off, locating a point on the curve directly. A study of the figure in combination with *Fig.* 3 will make the construction clear.

This curve is now graphically integrated to determine the curve of M_s. If p_4 is the pole distance for this integration the scale of M_8 will be 1 inch$=p_4mk$ inches$^3=p_4pm^2n$ inches^3. This curve has the same significance in regard to M_s as did the area curve previously described. That is, the ordinate at any point x gives the value of the statical moment about the Y axis of the section from c to x. The ordinate at d gives the value for the entire section from c to d. Note that in graphical integration the constant of integration is determined by fixing some predetermined point on the curve. In our case this known value is at the lower limit of integration, i.e. the left-hand limit of the section. The value here of the area, of the statical moment, and of the inertia is zero, and this point of the integral curves is therefore on the X axis. Note also that, contrary to the area and inertia, the M_s curve may have a negative value, indicating that the centroid lies to the left of the Y axis. These two points will be illustrated more specifically later.

The moment of inertia curve is arrived at in the same way. Mathematically

$$I=\int_c^d x^2\,dA=\int_c^d x^2\,[f(x)]\,dx$$

Now $x[f(x)]$ is the curve y_3 which we previously derived. Therefore a curve, $y_5=xy_3$ is required, i.e. we must again multiply by x to obtain a curve that may be integrated to obtain the inertia. The operation on the y_3 curve is identical to that just made on the original curve to obtain the y_3 curve. The elemental diagram of this process is illustrated in *Fig.* 5. The dotted lines illustrate the extension of *Fig.* 3 to obtain v, a value on the y_5 curve. The scale on the y_5 curve may be found in the same way and will be found to equal p_5km units$=t$ units.

This curve, $y_5=x^2[f(x)]$ is now graphically integrated to determine the I curve. If p_6 is the pole dis-

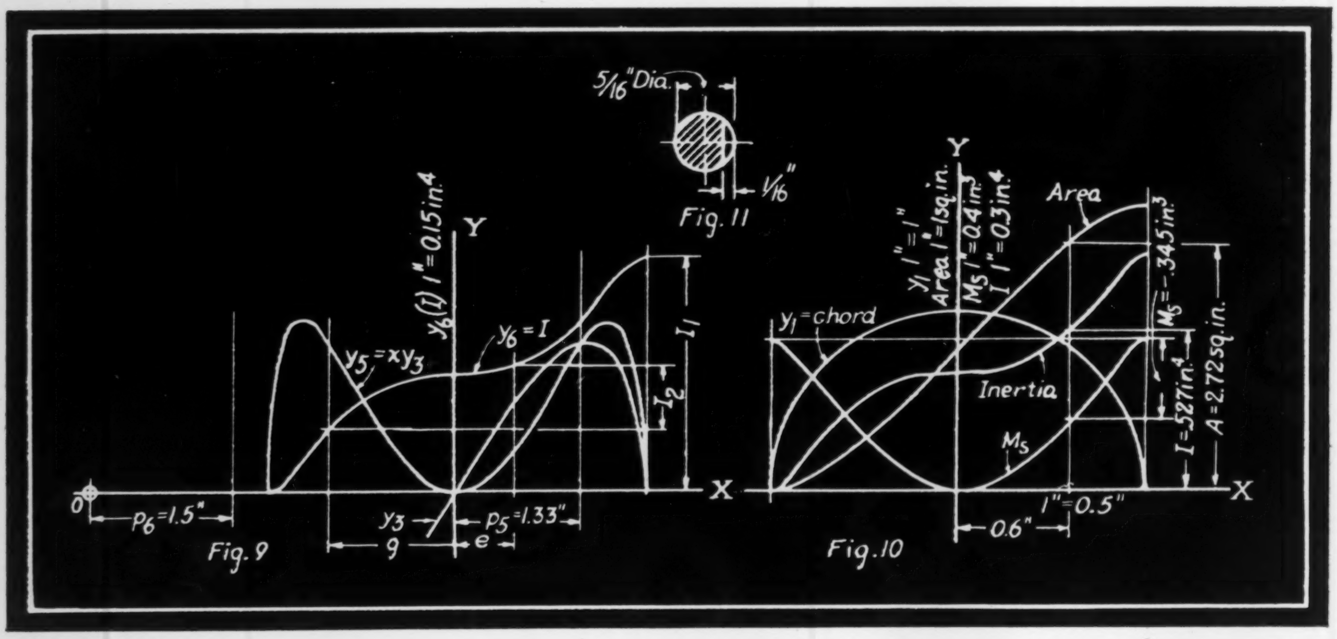


Fig. 9

Fig. 10

Fig. 11

tance for this integration the scale of I will be 1 inch $=p_6mt$ *inches*^{4}$=p_6p_5m^2k=p_6p_5pm^3n$ inches^4.

From the value of I (the inertia about the Y axis) determined from the above curve, I_0 (the inertia about the centroidal axis), may be determined from the equation $I_0=I-A\bar{x}^2$.

The above method will now be applied to a specific example. A regular curve that can be mathematically integrated will be chosen to permit a check of the accuracy of the work. The section used will be the part of the circle illustrated in *Fig.* 6.

The boundary curve as shown is two-valued (i.e. it has two values of y for each value of x). We will therefore consider only the part of the section bounded by the semicircle above the X axis, multiplying our results by two to obtain the value for the full section. The entire semicircle will be operated upon in order to permit any value of e or g. Since A, M_s, and I will vary directly as R^2, R^3 and R^4 respectively, our construction will be made for $R=1$, quantities for any other value being obtained by multiplying by the proper power of R. The curves will be denoted by subscripts as follows: (1) the boundary curve, (2) the area, (3) $x[f(x)]$, (4) M_s, (5) $x^2[f(x)]$, (6) I. The scale on the X axis equals that on the Y (for y_1) and $=m=0.5$ inches. *Fig.* 7 shows the integration to determine the area y_2. The scale is 1 inch$=p_2m^2=2\times(0.5)^2=0.5$ square inch. The curve is symmetrical with respect to its intercept on the Y axis and it is therefore necessary to make the construction for only one-half of it. In *Fig.* 7 the curve is located with its zero value at the left extremity of the semicircle. Therefore the ordinate at any point will give the area from the left end of the semicircle to the point at which the ordinate is taken. The value for the entire semicircle is indicated as A_1. To obtain our section we consider the X axis as relocated to pass through the intersection of the ordinate at $x=g$ with the curve (i.e. making $A=$zero at this point). We thus obtain A_2 for the area of our half section.

Construction of Curves Explained

Fig. 8 shows the construction of the y_3 curve and the integration of this curve to obtain M_s. The scale of M_s is 1 inch$=p_4p_3m^3=(1.33)\ (1.2)\ (.5)^3=0.2$ inches^3. The y_3 curve will be symmetrical about the origin and the M_s curve about the Y axis. For convenience of illustration the M_s curve is located with its zero value at the origin. An ordinate to the right will, therefore, give the value from the Y axis to this ordinate; the quarter circle to the right having the value plus M_{s1}. For the entire semicircle the X axis would be located to pass through the left-hand end of the curve. Thus the left quarter circle will have the value minus M_{s1}, the value for the entire semicircle being $M_{s1}-M_{s1}=O$. Similarly the value for our half section will be minus M_{s2}.

In *Fig.* 9 the right half of the y_3 curve is reproduced and the construction shown for the y_5 and the I curves. The y_5 curve is symmetrical about the Y axis and the I curve about its intercept with the Y axis. The scale of I is 1 inch$=p_6p_5p_3m^4=(1.5)\ (1.33)\ (1.2)\ (.5)^4=0.15$ inch^4. The value of the inertia for the semicircle is I_1, and for our half section I_2.

Since the values of the entire section are twice those scaled from the curves we can read the values directly by multiplying all our scales by two, i.e. y_1, 1 inch $=1$ inch; A, 1 inch$=1$ square inch; M_{s1}, 1 inch$=0.4$ inch^3; and I, 1 inch$=0.3$ inch^4. The boundary, area, statical moment and inertia curves are all reproduced in *Fig.* 10 with this change of scale, permitting direct readings of values for the full circle or section of a circle.

Unusual Case Encountered

A case that the writer recently encountered is the section shown in *Fig.* 11. We will use the curves just derived to obtain the values about the Y axis and will compute those about the centroidal axis after locating it. The values will be found first for a radius of 1 inch, converting then to the desired radius of 5/32 inch. The value of g (*Fig.* 6) will be R (1 inch); e will be $(5/32-1/16)\div(5/32)=.6$. The values of A, M_s and I as scaled from the curves are shown on *Fig.* 10. To secure the check mentioned in the earlier part of this article these values were also determined by mathematical integration. All three were found to check within one per cent.

The centroid will be at $-.345/2.72=-.127$ inch, $I_0=.527-2.72\times.127^2=.483$ inch^4. The distances to the extreme fibers are $1-.127=.873$ inch and $.6+.127=.727$ inch giving for the minimum section modulus $.483/.873=.552$. From these values we now obtain for the section of *Fig.* 11, $\bar{x}=-.127\times.1562=-.0198$ inch; $A=2.72\times.1562^2=.0664$ sq. inch; $S=.552\times.1562^3=.00211$ inch^3; and $I_0=.483\times.1562^4=.000288$ inch^4. It is interesting to note that, as compared with a complete circle, the section modulus is only 70½ per cent and the area is 86½ per cent.

In the case cited above no formulas could be found in any of the tables at hand. The mathematical integration was not particularly difficult, but the formulas obtained were rather long and cumbersome. The time consumed in the mathematical integration and substitution in the formulas was as much as that taken in the graphical method. It is felt that the chances of error are considerably greater. Moreover, at the completion of the analysis, if it were found desirable to adjust the section somewhat, it would be necessary to resubstitute in the formulas to obtain the new values, requiring considerable time. From the curves, however, the values could be read and the new S determined in a few minutes. The advantages of the method in a more irregular section are even greater.

Cover Plate Becomes Housing Structure

By Austin M. Wolf
Consulting Automotive Engineer
New York

EXCEPT for the introduction of hypoid gearing, little change has been made in the design of the automotive rear end since the almost universal, semifloating axle construction was adopted a number of years ago. True, after the advent of electric welding in automotive production lines the differential cover plate was welded to the back flange of the axle housing to obtain greater rigidity. But the increased strength from this construction was comparatively small and the stereotyped cover plate remained just that—a cover and not an integral part of the rear end design.

Cadillac Uses Built-In Cover Plate

This year the complete line of Cadillac has made a real advance by taking this almost semispherical member and building it into the housing. *Fig.* 1 shows the manner in which the cover extends to the inside of the front half of the rear axle housing. The housing itself is made by flash-welding two stampings together, *Fig.* 2. The spherical member is inserted between the upper and lower halves before this welding operation and subsequently spot-welded to the side of the differential carrier flange besides being held there by bolts which also hold the carrier to the housing as indicated at the right of the sectional view, *Fig.* 1. The cover portion of the spherical member is arcwelded to the rear flange of the housing in a complete circle, as shown in the bottom view of *Fig.* 2, except for a small formed section of the housing which makes a breather hole to prevent building up of pressure within from the heat of operation.

The chief difference of this construction over the conventional design is that the differential bearings are mounted in a tubular extension at each side of the differential case with the outer race rotating and the inner race fixed. The roller bearings are adjusted by means of a threaded plug.

Spiral angle of the hypoid gears has been changed from 45 to 50 degrees in the 1938 models.

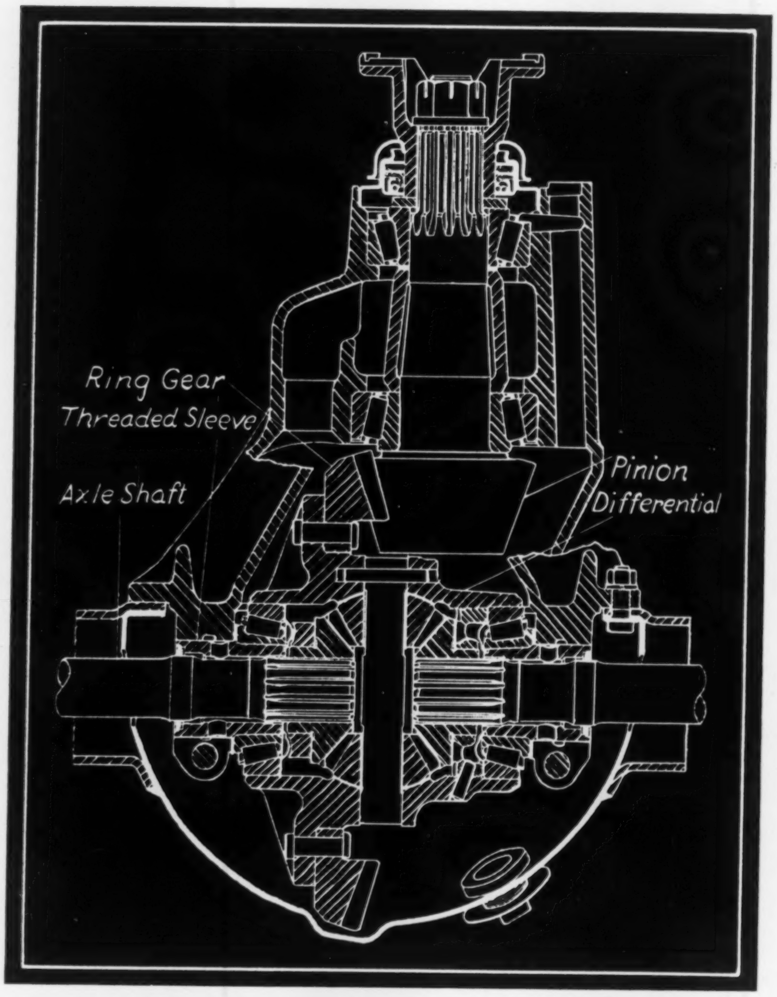
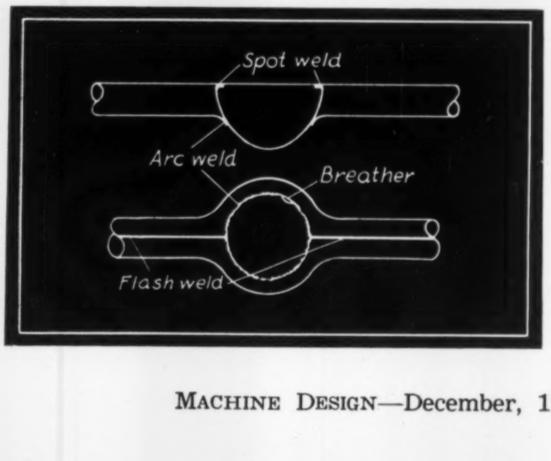


Fig. 1—Semispherical member is bolted and spot welded to differential carries flange, becoming integral part of construction

Fig. 2—Design by which former rear axle cover plate is built into housing is shown below



Valve Mechanism Gives Precise Control of Air Hoist

By A. M. Wasbauer

MODERN machine tools are built for high-speed production. If accessory equipment which includes work-handling devices does not possess the same degree of efficiency as the machine tool, then the value of the latter is materially decreased. Uppermost in the mind of the designer, therefore, is the need for fast operation and easy, sure control.

Air hoists have been adopted universally in large series production for handling heavy work because they are simple in construction, light in weight and fast in operation. Unfortunately in their present stage they are sometimes difficult to control because, owing to the compressible medium and the type of valve used, the operator cannot ascertain just where the load will stop. The present air hoist takes particularly careful handling and even then the work will

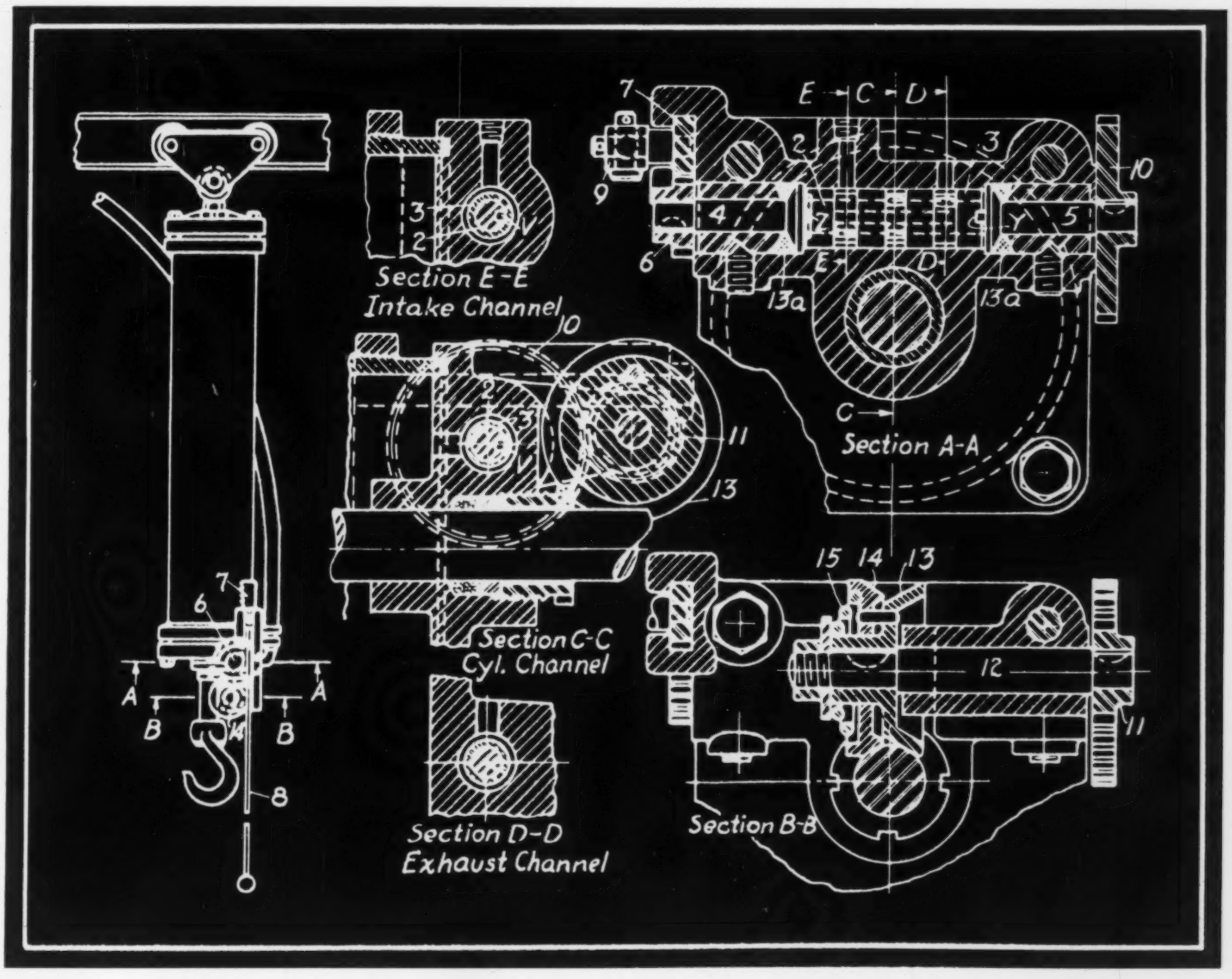

7
E
C
D
2
3
10
9
4
5
6
E
D
13a
13a
C
Section A-A
3
2
V
Section E-E
Intake Channel
10
2
3
V
11
13
Section C-C
Cyl. Channel
15
14
13
12
11
Section B-B
Section D-D
Exhaust Channel
7
6
A
A
B
B
14
8

Fig. 1—At the left is a view of a pneumatic hoist as described in the accompanying article. Cross sections of the valve control parts are shown at the right

often travel up and down short distances before reaching the desired position. Moreover in air hoists of conventional design the work cannot be moved slowly, say a fraction of an inch at a time, as with a mechanical hoist. The tool designer makes every effort to provide the utmost accessibility in the work holding fixture, yet unless the work handling hoist may be precisely controlled much of the benefit is lost.

The hoist described in the following provides: Better control of work in transit; slow instead of jerky movement; saving in work handling time and motive power; a degree of control comparable to that of a mechanical hoist but having the speed and other advantages of the pneumatic hoist.

Fig. 1 depicts the hoist as it appears with the piston all the way up. Air is admitted to and from the cylinder through a cylindrical rotating valve consisting of two members, a pilot 2 and a follower 3, both floating within their enclosure. The seat of the follower 3 is a straight lapped hole easily produced, the seat of pilot 2 is the straight lapped bore of follower 3. There are three peripheral channels in follower 3 and ports within these chanels designed to communicate with a longitudinal channel *V* in pilot 2 when this member is moved. See sections *BB, CC* and *DD*.

The pilot is driven by a tongue and groove through the shaft 4, pinion 6 and rack 7. The control rod 8 operates rack 7 vertically, a universal joint 9 connecting the two so that rod 8 may be swung away in any direction from the load. Raising or lowering rod 8 admits or exhausts air to and from the cylinder. The follower 3 is driven by tongue and groove *Y* through shaft 5, gear 10 and pinion 11 on shaft 12. This shaft receives its motion from the friction wheels 13 and 14 riding against the piston rod. Tension of the friction wheel on the piston rod is maintained by means of the spiral spring 15. These details merely indicate one form of construction; other simpler means may be found to utilize the same control principle.

Load Moves Only with Control Rod

We see now that pilot 2 cannot move in either direction without causing an identical movement of follower 3, which means that the load can move only in conjunction with the control rod, though at a greater rate. The velocity ratio between the two is the product of the ratio between gears 10 and 11, multiplied by the ratio between the pitch diameters of pinion 6 and friction wheel 13. With a load suspended in midair, the admittance port of the valve is kept open just enough to compensate for air leakage around the piston and piston rod. The load must remain stationary as long as there is sufficient pressure in the line to support it. An increase in the load while suspended would cause no noticeable deflection, but would admit only a greater pressure under the piston to counteract the additional weight. It is evident because of this design that the load cannot oscillate. The packing 13*a* is intended to exert enough pressure against the head of driver 4 to overcome the gravity of rack 7 and rod 8.

Two variations of design to provide functions that might be deemed desirable in some cases are possible. One suggestion would provide adjustable stops on rack 7 to limit the movement of the load in one direction or both. The second variation would eliminate rack 7 and replace pinion 6 by a sheave on which two cables or chains would be wound to replace the control rod 8. The proportions of the sheave, friction wheel and gearing could then be designed to give a displacement of cable equal or greater than the displacement of the load, with a proportional increase in the sensitiveness of control.

Artificial Rubber Sought World Over

NO SCIENTIST has yet succeeded in producing a compound which is chemically and physically indistinguishable from natural crude rubber. A half century ago he began to chase that will-o-the wisp. Now he doesn't care—at least for commercial purposes—whether he catches it or not.

In the days when chemists were bent on reproducing natural rubber exactly they decided that they must use as their immediate raw material some hydrocarbon—this because rubber was a hydrocarbon. And the best of these was butadiene—best because it could be obtained from cheap raw materials.

In Europe the whole chemical effort was bent toward getting this butadiene. Alcohol is one cheap source. Another is acetylene. Both are tapped in Europe. The Germans get their butadiene from acetylene; the Russians from alcohol.

In the United States artificial rubbers also are made. The most important source is not butadiene, but chloroprene, which was developed by du Pont chemists from discoveries made by the late Father Julius Nieuwland of Notre Dame university, and which, as its name indicates, contains a good deal of chlorine (40 per cent), something not found in rubber at all. In other words, the tradition that artificial rubber must be a hydrocarbon was abandoned.

Neoprene (chloroprene rubber) and Buna both resist the dissolving action of gasoline, oils and chemicals and the deteriorating action of heat and exposure to the air—something that rubber cannot do. Both are as good as rubber for waterproofing.

Natural rubber is so cheap here that an artificial substitute must meet urgent technical needs to command a price of about 75 cents a pound. It is precisely because it succeeds where rubber fails in the American duty-free market that chloroprene rubber can be made and sold in competition with crude rubber—WALDEMAR KAEMPFFERT in *New York Times*.

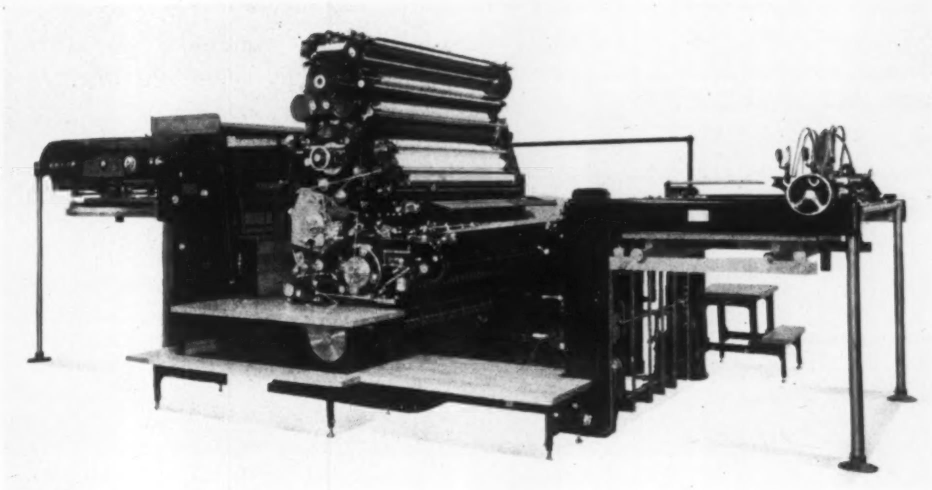


Fig. 1—Single color offset press is fully automatic. High quality of printing is produced because of precision design throughout

Speed Is Keynote of Offset Press

By Fred Kelly

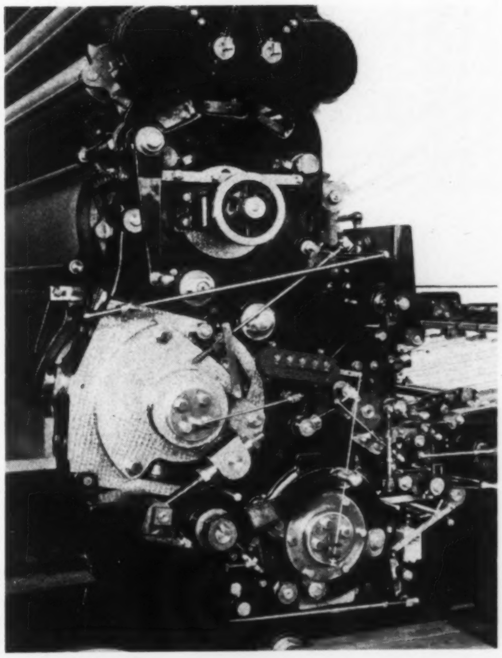


Fig. 2—Moving parts as seen on side of press are readily accessible for adjustment and lubrication

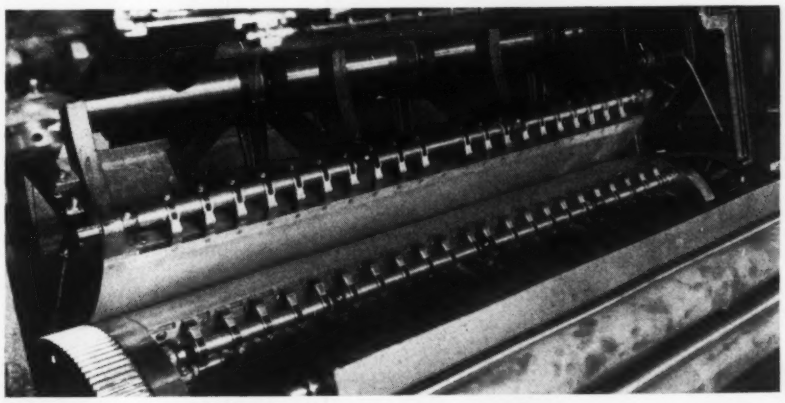


Fig. 3—Large number of grippers, made from steel stampings, hold paper sheets securely and bring them into position for printing

PRINTING presses never change, you say. Even a trained technician sees little difference between a large press 20 years old and one of the latest models. Both are about the same size, generally the lubricating system of the new, like the old, is manual, drive of the rolls is through helical or spur gears as it has been for years and there is little indication of a building-in of parts as is the trend with so many machines today.

But if one will roll up his sleeves and take time for more than a cursory examination of the working parts of a modern press, he will find a high degree of refinement over earlier models. Designers of these machines have not been sitting idly by while innovations of all kinds have been introduced in other machine fields. Of course, inasmuch as a large press costs over $50,000 and is expected to last a lifetime, the changes that are made in press design are usually well-tried and proved. One does not find mechanisms comparable to automobile trick gadgets which are popular for a season and are then snubbed by the buying public.

The majority of printing press refinements has been in the direction of obtaining more speed and thus a higher productive capacity. If a salesman is able to state and prove that his press will do the job of an older model in half the time, he has an unassailable argument. And so, as with most machines which turn out a product or do a specific machining job, the rate at which they work is the all-important consideration.

Secondary perhaps to the designer, but important when figuring the cost of manufacturing a machine so large and complicated as a press, is the use of more simple and less expensive parts where possible. This does not mean a sacrifice in performance or quality but merely the exchange of parts such as stampings for the more expensive machined or cast parts formerly used.

Depicted in *Fig.* 1 is a single-color, offset press manufactured by the Harris-Seybold-Potter Co. which is an excellent example of modern printing press design. Not only is it interesting from a mechanical standpoint, but the offset method of printing is gaining in popularity and presses of this type are being used more widely for various printing needs. This press prints sheets 42 x 58 inches at the rate of about 5500 per hour — feeding, printing, counting and stacking being entirely automatic.

Speed Depends on Efficient Feeding

Any redesign to increase the speed of a press must of necessity start with the feeding mechanism. If sheets are not fed properly and with sufficient speed then the operation of the entire machine is disrupted. Former practice was to feed each sheet separately to the grippers, *Fig.* 3, which clamp it securely and bring it into position to run between the impression and rubber rolls. As each sheet traveled several feet from the feeder to the registering clamps and at least two or three thousand are printed per hour, sheets moved with such speed that often the leading edge of the paper was mutilated when it hit the registering clamps, causing the paper to enter the rolls crookedly.

To overcome this trouble five sheets are now advanced at one-fifth the former speed to the registering device, one underlapping the other. Suction disks pick up the paper and advance it while blasts of air are blown under each sheet to lift it completely from the feeder pile. Corners are combed up by small fiber rollers to allow the air-stream to shoot well under the paper. This process takes place when the preceding sheet has advanced about a foot so that a continuous flow of underlapping sheets are slowly moving along the feeder instead of one sheet moving at a comparatively high speed. The new operation is principally one of timing, as all of the elements, i.e., suction, air stream, and fiber combs were utilized before, but not in the manner which permits the sheets to be underlapped.

Gripper fingers which may be seen in *Fig.* 3 are now made of steel for economy, lower weight and longer life than the parts formerly used. As a two-color press has 88 impression gripper fingers and 144 delivery grippers, the saving is considerable in weight and cost. Individual springs as well as one main spring actuate the gripper fingers, insuring that each bears evenly on the paper.

Higher speeds mean greater bearing wear and in the new Harris press we find the three heavy cast iron cylinders are now mounted on double row roller bearings. Bearings for the plate and rubber cylinders are built into the cylinders themselves and run on stationary shafts, as shown in *Fig.* 4. This design saves space as there is not enough room for the bearing mountings in the press side frames. However, the impression cylinder which is toward the bottom of the press is mounted on roller bearings in the frame.

Alignment between the plate and rubber cylinders must be absolutely accurate to prevent the slightest side motion or rotary play between the cylinders. For this reason each bearing is preloaded

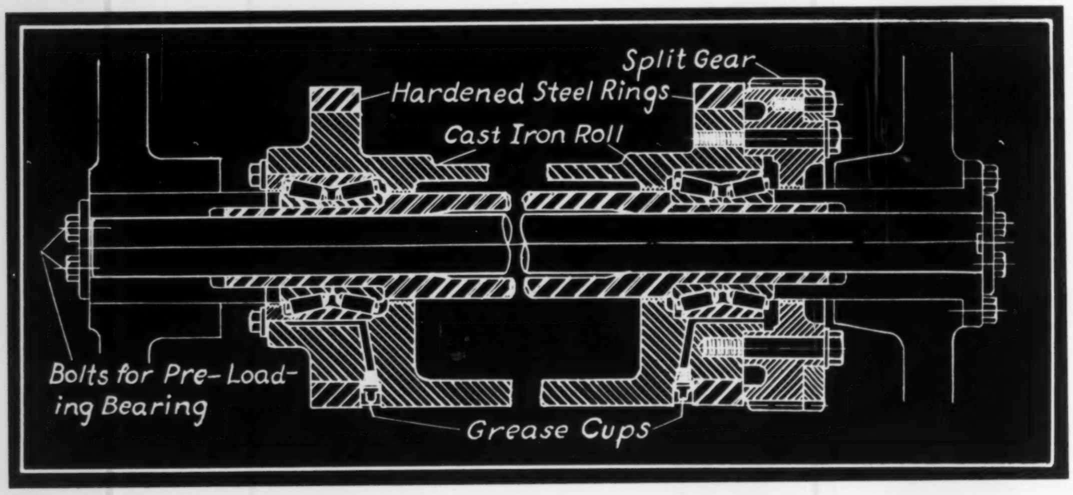


Fig. 4 — Cap screws set in end of shaft exert pressure against sleeve on double row roller bearings for preloading

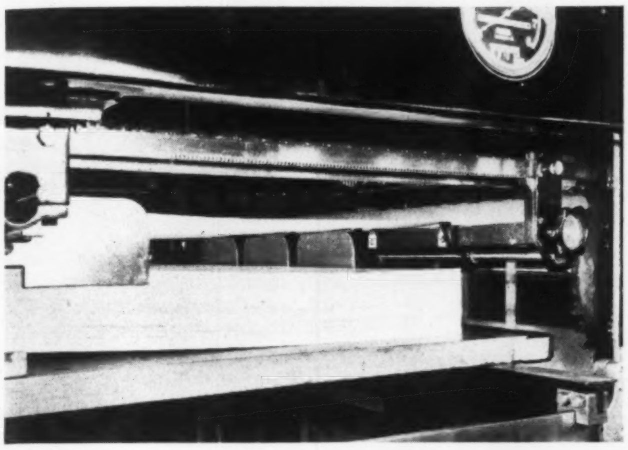
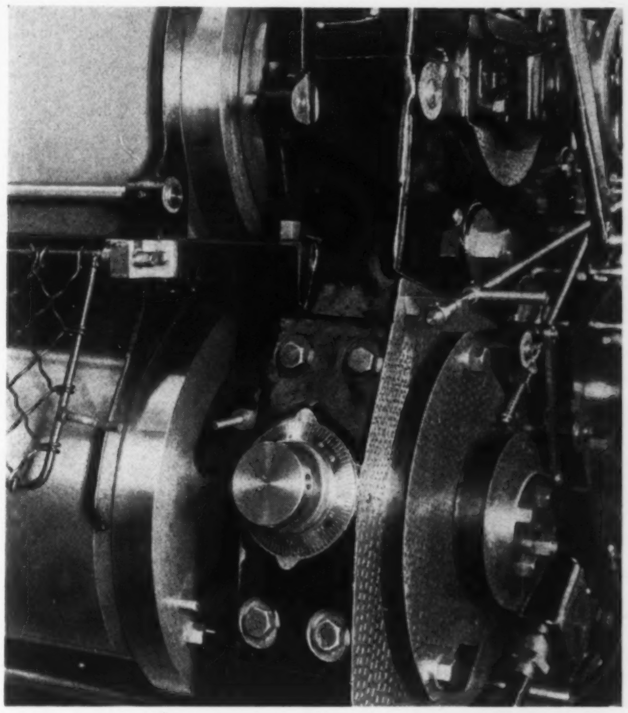


Fig. 5—Sheet delivery is facilitated by suction disks which move paper without allowing it to touch other sheets

Fig. 6—Below—Micrometer adjustment provides exactly correct pressure between plate and blanket rolls



by four bolts which draw up and force a sleeve against the bearing races, *Fig.* 4. A split spur gear is utilized on the plate cylinder and may be adjusted as wear takes place to prevent gear backlash.

Another antifriction bearing application in this type of press is for cam followers. Practically every operation of the machine is controlled by cams, and their free, quiet functioning is important. Rollers running on small needle bearings are found the most satisfactory, giving quiet operation with practically no wear.

Micrometer adjustments are provided for sideways motion of the plate cylinder and for pressure between the plate and blanket or rubber cylinders. These may be seen in *Figs.* 2 and 6.

A hardened steel ring, known as a bearer, is shrunk on each end of the plate and blanket cylinders. They may be seen in *Figs.* 4 and 6. Contact between the cylinders is made on these bearers which are kept constantly under pressure for extreme printing accuracy.

Water Used on Plate to Repell Ink

In the offset type of press both water and ink are used, one to repell the other. Two water rolls first cover the high spots of the printing plate, immunizing them, as it were, from picking up ink. The ink rollers are behind the water rollers and deposit their fluid on the other printing sections of the plate. To prevent corrosion, the water fountain vibration roller is of aluminum tubing and runs on two brass rolls covered with mollenton which contact the plate. Water pan and other parts which come in contact with moisture are brass.

Suction is employed for delivering the printed sheets as well as feeding them to the press. Freshly printed sheets will smudge if dragged across another sheet or if laid on the adjacent one immediately after coming from the press. To avoid this, suction disks hold the printed sheet away from the finished pile while being carried into position, as shown in *Fig.* 5.

Built into the press is a tachometer type dial counter which gives at a glance the number of impressions being made per hour. The instrument is recessed in the frame of the machine out of harm's way but easily read. Operating from the blanket roll, as seen in *Fig.* 2, is a counter which gives the actual number of impressions made in a printing run.

In step with modern design, the press utilizes built-up parts for the base. Heavy sections of rolled steel arc welded together are used for these structures. Greater rigidity is claimed and cost is reduced somewhat. The cast iron side frames are heavier than is necessary for ordinary conditions, but as the slightest set or sag of a supporting structure would throw the entire mechanism out of kilter, unusually sturdy sections are used. To insure accuracy the two side frames are bored and machined together.

Aim of the designers has been to give speed with safety and quality. Because of automatic devices, no operator need touch the press during a run. By building the machine with the utmost care and using design construction that will bring the optimum in accuracy this condition has been successfully met. Mechanisms which must be adjusted are easily accessible as are the plate and blanket cylinders. Refined design enabled this press to meet the production needs of today just as original, inventive design made it a leader in the field 40 years ago.

Perpetuum Mobile!

By T. C. Lloyd

ADVANCES in science and technology, remarkable as they are, nevertheless have robbed us of some of the thrills connected with attempts at invention. What, for instance, could be more exciting than to believe oneself to be on the verge of discovering perpetual motion?

Perhaps even today there are mechanics tinkering far into the night on perpetual motion machines, despite the fact that to nearly everyone the idea has long since been reduced to an absurdity. Be that as it may, it is a fact that over a period of at least 700 years fully as much time and effort were spent on such attempts as are now expended on radio contests.

Perpetual motion was defined by one of our Commissioners of Patents as ". . . . a mechanical motion creating energy . . . a machine doing work and operating without the aid of any power other than that which is generated by the machine itself. . . ." But the United States Patent Office, so we understand, is not bothered by the handling of perpetual motion patents because it adheres to the rule that a working model must be submitted with each application!

The British Patent Office, operating without that restriction, has received hundreds of applications. Its first perpetual motion patent actually was granted in 1635 without even the formality of demanding a description of how the device operated.

Solution Sought in Chemistry

Undismayed by their knowledge that the basic principles of statics, dynamics, hydraulics and thermodynamics denied the possibility of perpetual motion, our inventive forefathers looked for it in the realm of chemistry. Here is an old-time formula quoted from Henry Dirck's *Perpetuum Mobile*:

"Mix five ounces of mercury with an equal weight of tin; grind them together with ten ounces of sublimate; dissolve them in a cellar upon some marble for a space of four days till they become like oyl-olive; distill them with fire of chaff or driving fire, and it will sublime into a dry substance. . . .which, being put into a glass that is well luted and kept dry, will have a perpetual motion."

More than one inventor, despairing of discovering the combination required to make his perpetual motion machine work, succumbed to temptation and "faked the results". There were many of this ilk, an outstanding example being one Redheffer, who in 1812 gained the unique honor of having a commission of "eminent engineers" appointed by the Pennsylvania legislature to investigate his claims.

Redheffer's device consisted of a horizontal disk on which there were several inclined planes. As this disk revolved, small cars ran up and down the planes, these presumably affording the motive power. Gear teeth on the disk engaged with an intermediate gear wheel, which in turn appeared to drive the rest of the mechanism. The legislative commission did not directly discover the secret of this mechanism. Fortunately, however, one of the members took his young son with him on the investigation.

Gear Evidence Shows Fake

This young man, Coleman Sellers (destined to be the father of Dr. Coleman Sellers, noted Philadelphia machine tool builder), reported to his father the one bright idea developed out of the whole investigation. "The machine is a fake", young Sellers said, "because the wrong sides of the gear teeth show wear." In other words, it was obvious to him that the horizontal disk—instead of being the driving member as claimed—actually was merely a driven member.

This same young man, whose name belongs in the hall of fame of practical jokers, proceeded to have constructed an apparent duplicate of the Redheffer machine, with a small driving clockwork actually concealed in its ornamental framework. When this duplicate was exhibited to Redheffer, the surprise and chagrin of that imposter can well be imagined. This youngster somehow seemed to have supplied the vital element which he secretly knew his own device lacked.

Failing to buy out the Seller's development, Redheffer transferred his activities to New York. There he had the misfortune to accept a dollar admission fee from Robert Fulton of steamboat fame. Fulton upon watching the device perform detected that it was operated by a crank motion.

Fulton, with the help of his companions, demolished the machine, thereupon discovering hollow braces through which ran a small belt. This belt lead to a loft where the actual "power plant" was concealed. This proved to be ". . .a poor old wretch, with an immense beard, and all the appearance of having suffered long imprisonment; who, when they broke in upon him was unconscious of what had happened below and who, while he was seated on a stool, gnawing a crust, was with one hand turning a crank."

And that, figuratively speaking, goes for all perpetual motions—there must be a crank behind them somewhere!

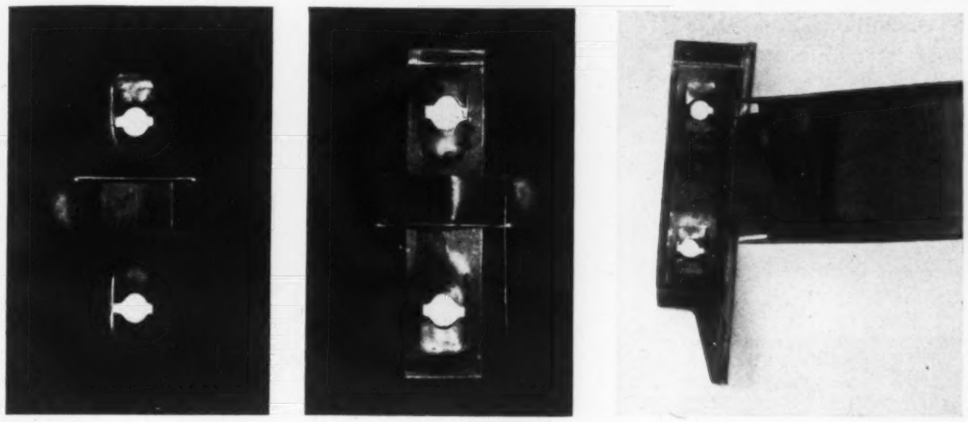


Fig. 1—Unretouched photographs of special speed-nut elements as successfully applied in connection with assemblies involving heavy gage sheet and pressed metal. Outside and inside views at left show retention by loop integral with sheet, while at right "tacking" is by spot weld

It Pays to Consider the Unusual in Fastenings

By

Guy Hubbard

THE field of mechanical fastenings is one in which standardization has reached a high point. Such matters as shape and pitch of screw threads; and sizes, shapes and metallurgy of screws, bolts, studs, nuts, washers, pins, rivets, etc., have—over a long period of years—been subjected to critical study and experiment toward the end of simplification and efficiency. So thoroughly has this job been done that to meet any ordinary design and assembly problem it is not very often necessary to resort to the nonstandard shapes and sizes with which old-time drawings were so frequently encumbered.

There have lately been developed, however, a number of new varieties of fastenings which generally supplement those of ordinary type, but which may in some cases replace them under certain assembly conditions. The advantages and the reliability of some of these new types of fastenings have been so thoroughly proved in practice that it behooves designers—especially those designing for economical, high speed mass production—to become well acquainted with their characteristics and possibilities.

Adoption of these new types of fastenings has been earliest and most wide-spread among manufacturers of automobiles, refrigerators, gas and electric ranges and other products in which considerable sheet and pressed metal assembly is involved. Hence the idea may have grown that they are suitable only for fixed assembly of thin gage material; that is, as fastenings which never can be removed. While that is true of some of the fastenings in some cases, it is by no means a general condition.

The field of usefulness of many of them extends much further than that

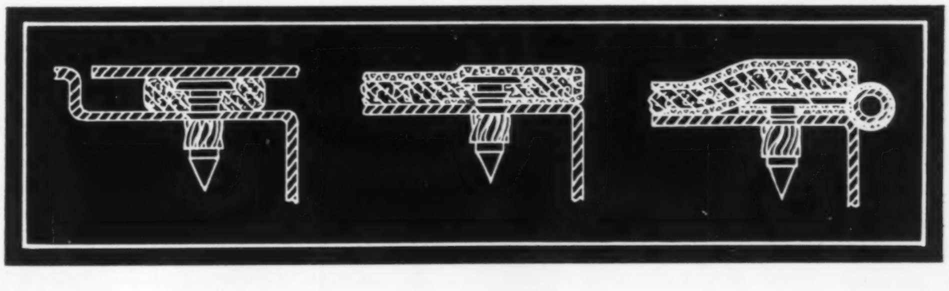


Fig. 2—Methods of using hardened drive screws for (left to right) attaching "anti-squeak" to hood ledge, for securing trim panel in place and for fastening windlace to an automobile door. The screws are simply hammered into drilled or clean-punched holes in the foundation sheets

particularly in the direction of economical and quick assemblies which can be taken apart deliberately but which will not come apart prematurely as a result of the inevitable shocks, vibration and flow of metal which occurs in long, hard service. It extends also to the thicker sections common to the rods, bars, structurals and castings used in building modern machinery.

Unless the engineering department already is thoroughly familiar with the proper selection and application of the newer types of fastenings, it is highly desirable that the designers work closely with the assembly engineers of their own company and with the applications engineers of the fastenings manufacturers before writing definite specifications on the drawings. If the problem be one of overhauling an existing design, the applications engineers can do a very effective job by direct study of the "growth" of the product on the assembly line; their recommendations then being perfected and checked with engineering, assembly and testing departments.

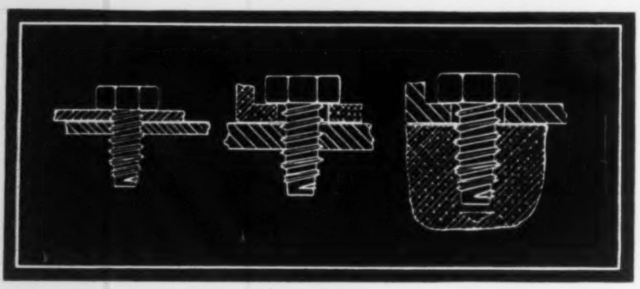


Fig. 3—Left to right—Hardened self-tapping cap screws connecting light sheets; fastening to plate or structural; and to aluminum castings or the like

In the case of a new product, or of a sweeping redesign of an older one, it is a good plan to have the applications engineers of the fastenings manufacturers "in on the thing" with the engineering department while the design still is on the board in its earlier stages of development.

Variety of Fastenings Is Wide

While the variety of what may be called the more or less unusual types of fastenings has within the past few years grown rather large, there have been selected for consideration in this article only a limited number of them. These have been chosen to some extent at least because of their possibilities to machine construction in general, as well as to the more highly specialized fields of very large quantity mass production.

One of these is what is known as the speed-nut, which because of the numerous forms in which it now is made might perhaps better be characterized as a fastening system than as a fastening unit. This item, which originally was developed by a stove company for the economical and secure assembly of gas ranges, was first put upon the market in a few simple forms for use in similar work. Through the efforts of applications men in the field, backed up by constant experimental engineering on the part of the manufacturer, the original purpose has very rapidly been outgrown until today the nut is made in between 200 and 300 varieties, many of which have been developed for unique special purposes.

Basically the nut is a spring-tempered stamping with body arched to give a large range of spring tension to resist vibration, and with central raised prongs whose V-shaped ends are accurately formed to fit into a standard bolt or screw thread both as to contact and as to pitch. These can be screwed on like any nut, or for fast assembly can be snapped on by means of a tool something like a hollow punch.

Their holding and locking power comes not only from the spring tension of their flattened arch when tightened, but also from the closing in on the thread of the raised prongs, which give a vise-like grip at the moment of final tightening. These prongs let go readily without damage to the thread when deliberate unscrewing takes place but they hold tenaciously against vibration. Incidentally these nuts, which in their simple form will resist any ordinary stripping action, are for extra heavy service made with two sets of prongs on one side and one set on the other.

Practical Applications of Speed-Nuts

In *Fig.* 1 there are shown two of the many ways in which the speednuts are being used to solve assembly problems, the units in both cases being double ones of special design to suit individual cases. The first two (left to right) are outside and inside views of a sheet in which the nut unit is retained by being sprung into a loop integral with the sheet against which some other element is to be fastened by screws. The third cut shows a similar nut unit used in assembly of an automobile. To hold it in place

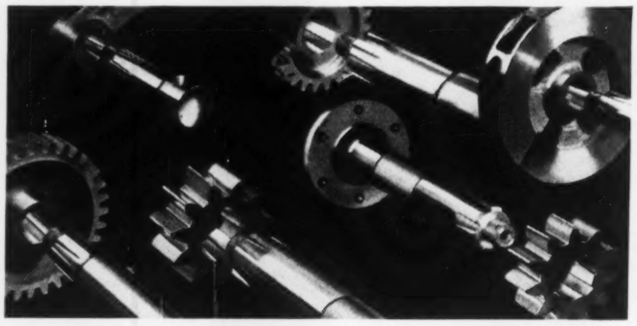


Fig. 4—Tapered multiple spline system gives increased contact area and high torsional strength at connections between machine elements such as these

it is "tacked" to the frame member by a spot weld.

These nuts are also made without lead for fastening die cast and molded plastic parts without resorting to inserts. Smooth round stems are made integral with the parts and the "leadless" nuts are simply pushed down upon them. To allow removal, the cast or extruded stems are made with a flat side which causes the nut to release when given a quarter turn. This system is widely used in applying medallions, name plates and decorative strips.

Another form of fastening which is being widely adopted is the hardened screw which is applied in metal without requiring tapped holes. Two kinds are commonly used in machine building; one being the drive screw used for permanent fastenings, the other the self-tapping screw which can be unscrewed..

The drive screw, which apparently developed from the old-fashioned escutcheon pin, has far outgrown its original use as a fastening for name plates. In its modern form, which is widely used in sheet metal assembly, it has a sharp point, a spirally fluted body and a head suited to the particular service for which it is intended. These are simply hammered into drilled or clean punched holes of the proper size, just as a nail is driven into wood. Once driven in, they will stay in even under severe vibration. Three typical applications of these drive screws are depicted in *Fig.* 2, these being — left to right — the fastening of anti-squeak material to a hood ledge; trim panel to body; and windlace to automobile door.

How Self-Threading Screws Work

The other type of hardened screw, which probably has even wider applications in general machine construction, is the self-threading screw, shown in the form of cap screws in the three application diagrams, *Fig.* 3. Holes made for these screws are somewhat larger than the root diameter of the rather widely spaced special threads on the screws. As they draw themselves into the work they form their own thread in the material by action similar to that of rolling a thread. Because of the tight fit they will stay in until intentionally removed.

The smaller sizes, which are made with the several types of standard slotted heads, are particularly useful in effecting assembly of sheet metal to sheet metal. The cap screws in particular, which are standard up to ½-inch diameter, not only will work satisfactorily in sheet metal as light as 24 gage (.025 inch), but also in steel plates and structural shapes up to ½-inch thick and in solid sections of many other materials including brass, bronze, aluminum, die castings, plastics, etc.

A trouble point in machinery always has been the shaft-end connection with gears, levers or other members subject to reciprocation and shocks.

Having in mind the practical success of the familiar straight splined shaft with its four or six integral keys, which is widely used with sliding gears and clutch mechanisms, a machine tool builder has within recent years worked out a modification of this system which insures strong, solid connections on shaft ends. This builder also has developed machines and cutters for doing this work. The nature of this taper spline system, both as to shafts and hubs, is clearly shown by *Fig.* 4.

This taper spline is essentially a hobbing development, the integral keys and the tapered root diameter being hobbed in the end of a straight shaft in much the same manner — and with the same speed—as gear teeth or straight splines.

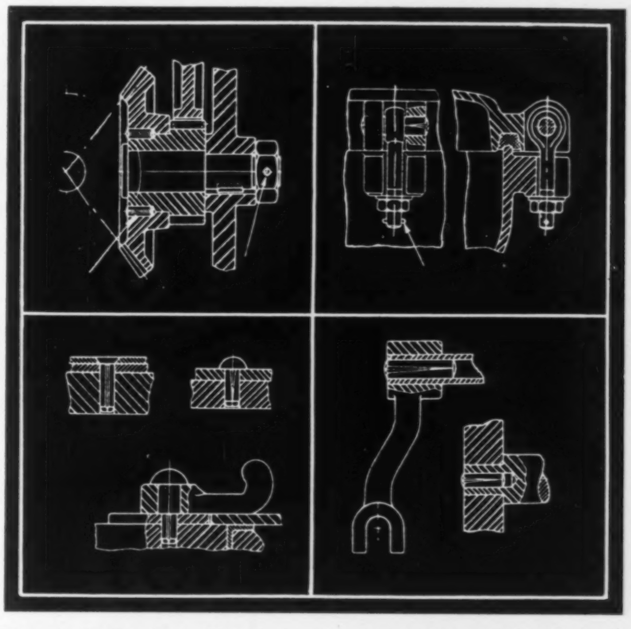


Fig. 5—Typical applications of groove-pins, and standard and special drive-studs, in machinery assembly

When connections to shafting are mentioned, the use of pins naturally comes to mind, even though not commonly applying in extra heavy duty service such as just considered. Here again a relatively new system has assumed considerable importance. This system is exemplified in a wide variety of shapes and sizes of groove-pins which can be driven directly into plain drilled holes, without reaming.

These pins (and related drive-studs), of which several machinery applications are shown in *Fig.* 5, are formed by pressing three longitudinal grooves into a straight cylindrical body, thereby upsetting the stock at its periphery. Driving into a drilled hole forces the bulges partly back into the grooves, thereby producing a vibration-proof force fit. These pins can be driven out and replaced repeatedly.

MACHINE DESIGN thanks Tinnerman Stove & Range Co.; Parker-Kalon Corp.; Barber-Colman Co.; and Groov-Pin Corp. for illustrations and assistance in preparation of this article. In subsequent issues various other important fastenings will be dealt with.

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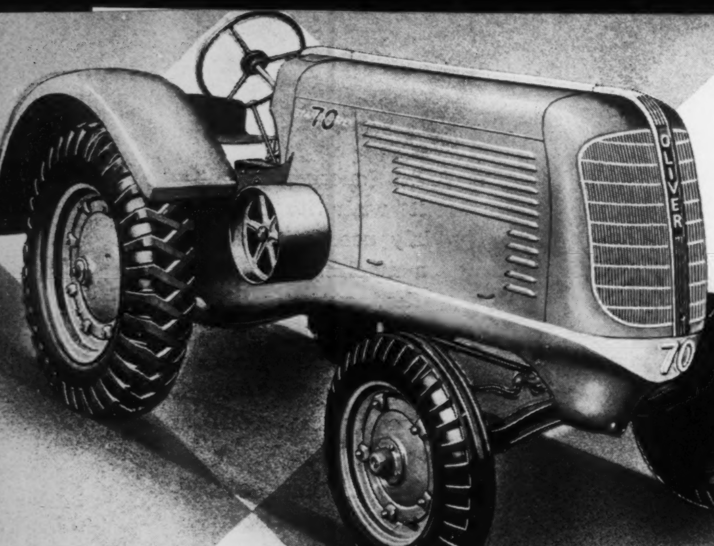
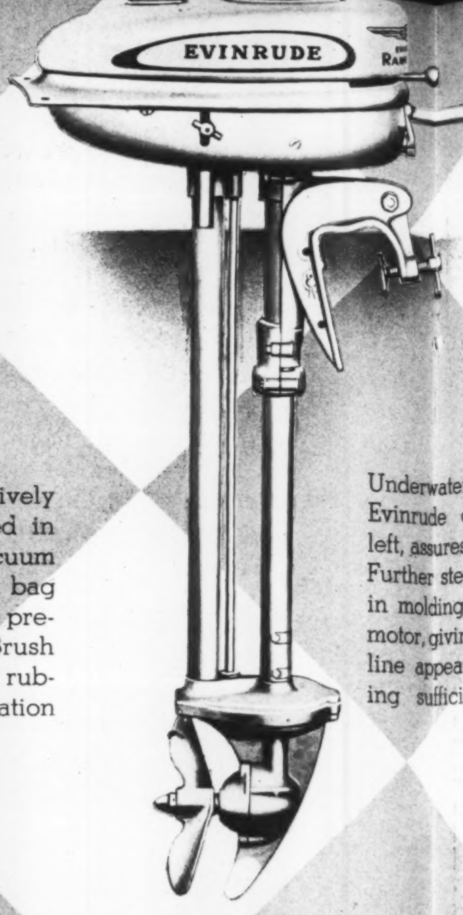


Styled by Wilbur Henry Adams for orchard and farm work, the Oliver tractor, above, has protruding parts such as radiator and gasoline caps placed under a channel section running the length of the hood. Baked automotive finish gives attractive appearance

Because of comparatively high pressure developed in the Westinghouse vacuum cleaner, left, a moleskin bag with thick nap is used to prevent dust leakage. Brush bearings are mounted in rubber for extra quiet operation



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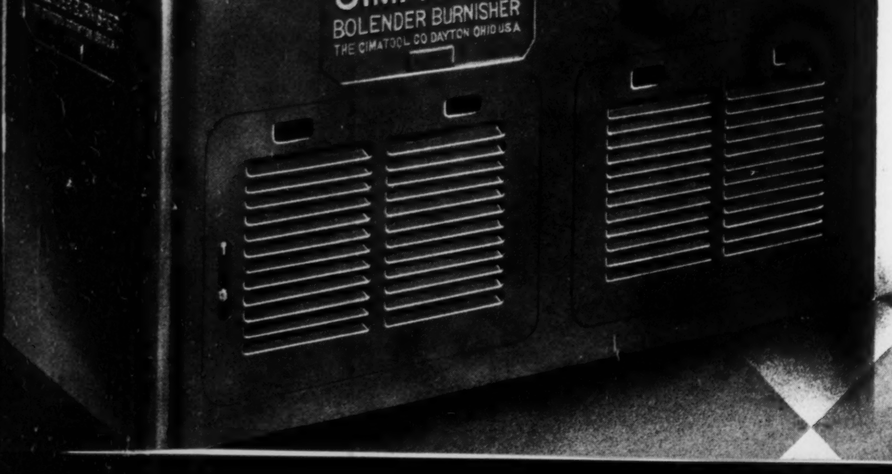
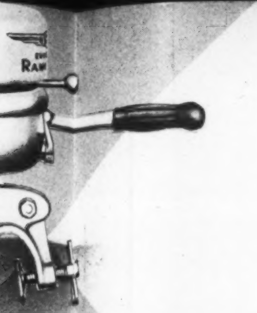
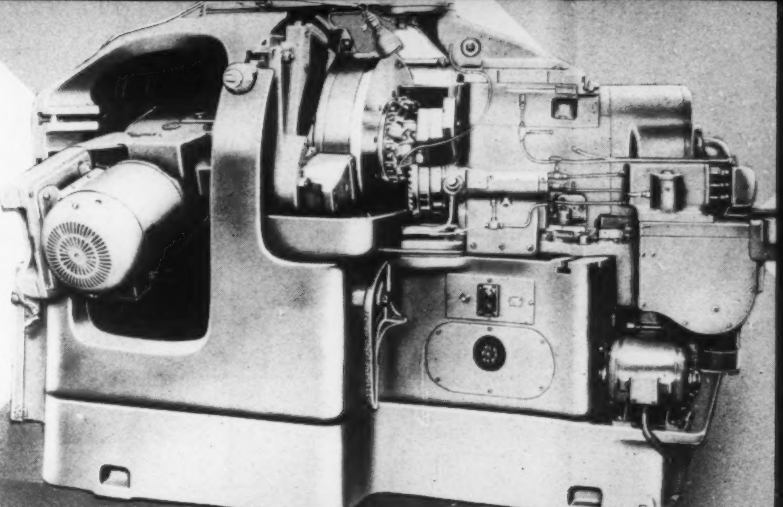
Unusual building-in of parts has been accomplished in the Cimatool gear burnisher, below. Large, louvred doors provide adequate cooling of motors, pumps and piping contained in the base. Sight gage informs operator of exact level and flow of lubricant in drive compartment



Output of the Doering butter printing machine, below, is regulated by a directly connected variable speed motor. Striking finish is obtained by burnishing stainless steel, liberally used to prevent contamination of the product. The machine to the right cuts the butter to size and weight



Heavy section castings, generously ribbed, provide exceptional stability on the Gleason spiral bevel and hypoid gear finishing machine, right. All fatiguing manual operations are eliminated and special safety devices are embodied, making machine practically foolproof



Underwater exhaust on the Evinrude outboard engine, left, assures utmost quietness. Further step has been made in molding gas tank around motor, giving decided streamline appearance yet providing sufficient capacity for fuel

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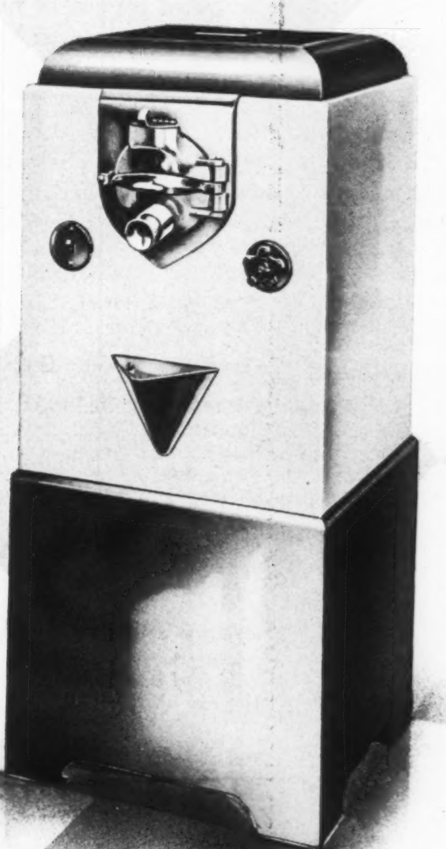
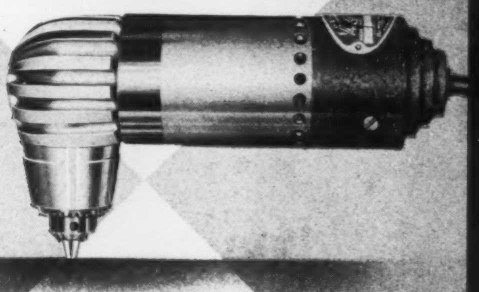


Overall length of Black & Decker drill, below, is reduced by mounting chuck spindle at right angles to the motor. Deep cast air vents not easily covered by operator's hands assure adequate circulation around motor



Hobart dish washing machine, below, is so designed that all parts are accessible from front allowing machine to be placed permanently against a wall. Conveyor is constructed to give ample carrying room for dishes and silverware with no waste of heat and water

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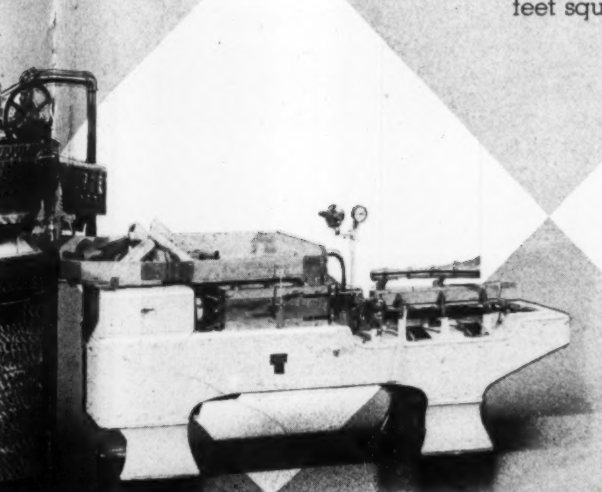
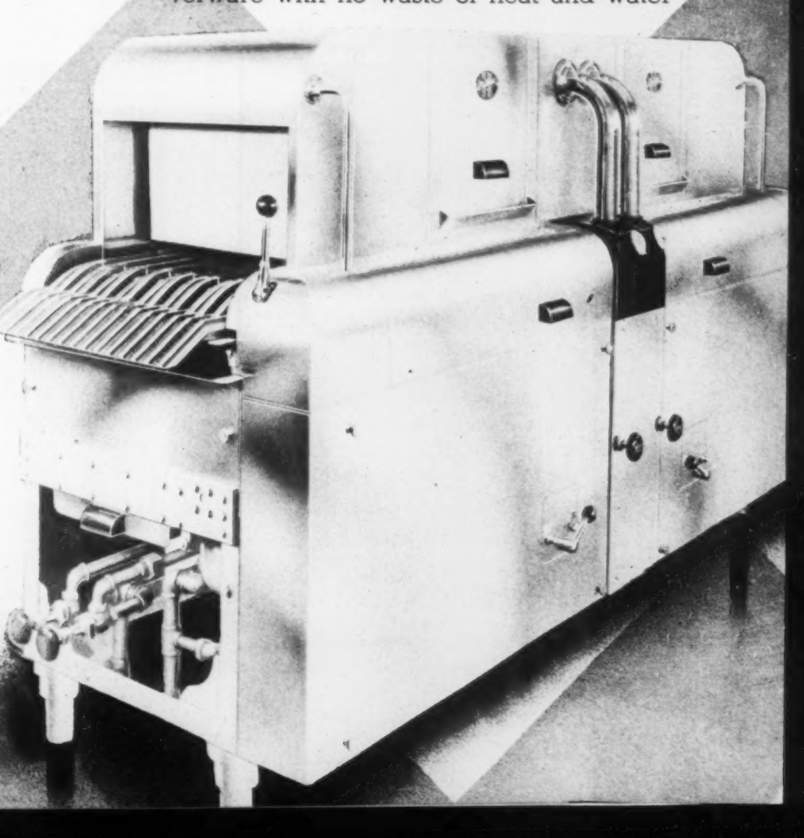
Freezing chamber and beater of the ice cream making Freez-Master, above, are of Monel metal and nickel silver. Compressor, motor and other freezing mechanisms are completely enclosed in metal case less than two feet square





New Machines Indicate Design Trends

GENERAL tendency among machine manufacturers is to shorten finishing schedules by taking advantage of new types of finishes which can be applied more rapidly than those of older types. Where such finishes are being used, production is being speeded up, costs reduced and inventories cut down. The speeding of the finishing operation is being accomplished by: (1) Using lacquer-enamels that air-dry rapidly; (2) employing enamels that may be baked rapidly at high temperatures; (3) baking a system of undercoats at the same time instead of baking each individual undercoat separately; and (4) using a neutral undercoat instead of special undercoats for each final color. All products are shop finished in this standard coat and then finished in any desired color. In a later issue of MACHINE DESIGN an article on new specialty machine finishes and trends in finishes will be featured.

Air Conditioning

Ceiling type air conditioner, Fitzgibbons Boiler Co. Inc., New York.
Air circulator, Pacific Mfg. Corp., Chicago.

Bottling

Container washer, United States Bottlers Machinery Co., Chicago.

Confectionery

Chocolate coater and cooling tunnel, Ben-Moore Mfg. Co., Brooklyn, N. Y.

Construction

Asphalt mixer, Iowa Mfg. Co., Cedar Rapids, Ia.
Crawler tractor, with rubber track, Marmon Herrington Co., Indianapolis.
Compressor, Davey Compressor Co., Kent, O.
Self-priming pumps, Construction Machinery Co., Waterloo, Ia.
Traffic line marker, Lewis Mfg. Co., Decatur, Ill.

Dairy

Milk heater - cooler - regenerator, Creamery Package Mfg. Co., Chicago.
Pasteurizer, Glascote Products Inc., Cleveland.

Domestic

Four-slice toaster, Utility Electric Co., St. Louis.
Electric washer, Westinghouse Electric & Mfg. Co., East Pittsburgh.
Combination washer-ironer, Apex Rotarex Corp., Cleveland.
Revolving brush hand cleaner, P. A. Geier Co., Cleveland.
Porcelain electric range, Frigidaire Div., General Motors Sales Corp., Dayton, O.
Cordless electric iron, Electrical Products Co., Detroit, Mich.

Finishes

Compressor for paint spraying equipment, W. R. Brown Corp., Chicago.
Portable electric sanding, rubbing and polishing machine, Finishing Equipment Co., Indianapolis.
Color blend machine, Lockwood Electric Co., Cincinnati, O.

Food

Solvent recovery still, Barnstead Still & Sterilizer Co., Forest Hills, Mass.
Nut breaker with sieves, Thomas Mill & Bro. Inc., Philadelphia.
Peanut butter mill, Jabez Burns & Sons Inc., New York.

Industrial

Concrete floor filler, Truscon Laboratories, Detroit.
Delivery truck, White Motor Co., Cleveland.
Machine for transporting liquids, Moorehead Mfg. Co., Detroit.
Automatic machine for fluxing, Automatic Gasflux Co., Cleveland.

Instrument

Heart testing machine, Sanborn Co., Cambridge, Mass.

Metalworking

Nibbling machine, W. J. Savage Co. Inc., Knoxville, Tenn.
Carbide tool grinder, Baldor Electric Co., St. Louis.
Roll grinder, Landis Tool Co., Waynesboro, Pa.
Precision grinder, The Hisey-Wolf Machine Co., Cincinnati, O.

Office

Combination desk radio, Sengbusch Self-Closing Inkstand Co., Milwaukee.
Check protector, Hedman Mfg. Co., Chicago.
Automatic check signing machine, Check Writer Co., New York.

Printing

Automatic locking EasyKasters, Hammond Machinery Builders Inc., Kalamazoo, Mich.
Book folding machine, Dexter Folder Co., Pearl River, N. Y.
Fanfold perforator, F. P. Rosback Co., Benton Harbor, Mich.

Quarry

Quarry truck, Hug Co., Highland, Ill.
All-steel drills, Keystone Driller Co., Beaver Falls, Pa.

Restaurant

Electric sandwich grill, Griswold Mfg. Co., Erie, Pa.
Broiler-griddle, Star Mfg. Co., St. Louis.
Electric dishwasher, Campbell Mfg. Co., Los Angeles.
Ice cream freezer for counter use, Bastian Blessing Co., Chicago.
Automatic ice cooling machine, Flynn & Emrich Co., Baltimore.

Textile

Cotton comber, Whitin Machine Works, Whitinsville, Mass.
Electric multiple die creaser, Fidelity Machine Co., Philadelphia.
Package yarn dryer, Proctor & Schwartz Inc., Philadelphia.

Woodworking

Safety saw, Stanley Electric Tool Div., Stanley Works, New Britain, Conn.
Woodworking shaper, Boice-Crane Co., Toledo, O.

New Conditions Stimulate Design of Self-Contained Machinery

LABOR unrest is apt to exert more influence on design of machinery than any other single factor in the immediate future. Already it has made itself felt in the speeding up of machines, and it also is having its effect in strengthening the trend toward more complete specification and building-in of machine parts.

Indicative of the steps being taken in this direction and of the necessity for machinery manufacturers to recognize the condition is the method adopted by General Motors in equipping their new plants from the standpoint of "mobility" of the machinery installed. No machine beneath a certain weight or size is even being anchored in position, with the result that complete rearrangement of the plant itself can quickly and efficiently be made, or whole batteries of machines can readily be removed to plants located elsewhere if necessary.

Primary among the parts that necessarily must be built into machines to accommodate such a plan are, of course, the motors and controls. These are already being furnished as integral parts of the machines in most cases. Supplementing these parts, however, as original equipment, will be products such as vibration dampening devices, pumps and blowers, internal combustion engines for certain types of machines and conditions, and other machine parts that rightly can be specified in the original design.

For many years machines have been considered more and more as self-contained units. It is safe to say that with the present stimulus created by labor conditions the vast majority will shortly be so complete in themselves as to require no additional or auxiliary parts after delivery, and an absolute minimum of time and effort before they actually can be installed in the plant ready for operation.

• • •

Ideas Create Sales

ONE thing that truthfully can be said about automobile designers is that they are willing to "try anything once"! They often do—and the only reason their companies do not suffer materially as a consequence is that the things they incorporate in new models usually have behind them some basic soundness from a mechanical, electrical or aerodynamic standpoint.

In 1933, Austin M. Wolf, writing in MACHINE DESIGN, told of the ideal control that would make almost automatic the gear-changing and braking of the car. Great progress and many changes have taken place since that time, as observation of current models discloses, but there still is a long way to go.

The main thing about automobile engineers is that they are not easily discouraged by temporary fickleness on the part of the public. They recognize that new ideas and new devices sell cars, and never permit redesign to become stagnant.

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Thinks We Are Going High Hat

To the Editor:

I HAVE been reading MACHINE DESIGN for over five years and it is still very interesting to me. You have dealt with many helpful topics in that time, and the Directory of Materials in the October issue is not the least of these. . . .

It seems to me, however, that MACHINE DESIGN is following the general trend of many publications in that the articles appearing therein are becoming more and more suited to the "technical engineer" type of designer rather than the draftsman type. In other words, may we say there is danger of your going "high hat."

Articles for Draftsmen Suggested

Now I wouldn't dare be critical if I didn't feel that I could submit a constructive solution. It must be extremely difficult for an editorial department to constantly accumulate articles of interest, timeliness, originality and ingenuity. May I suggest a series of articles covering modern drafting, blueprinting, tool design, pattern shop, foundry, machine shop, stores and assembly departments? Take us into rolling mills and show us how sheets and bars are made. We are also interested in the making of springs, screws, plastic molded parts, wire, paper and a host of others. Assume a simple attitude and get right down with the operators and tell how things are really done. Write it as the superintendent of a department would tell it to his son.

Perhaps this sounds elementary to you, but let me remind you that many of the members of the drafting rooms come right from high school or technical school and miss all shop experience; then too, many methods have changed since we oldsters worked our way through the shops.

Now I thank you for your attention and beg your pardon if this letter sounds as if I presume to know too much. The intent is to let you hear from "Vox Populi" which I believe is the desire of every editor.

—ANDREW BULLMER
Chief Draftsman, Wagner Electric Corp.

EDITOR'S NOTE: Constructive criticism and suggestions are welcome. MACHINE DESIGN is always glad to hear from readers regarding current or suggested editorial content.

Thank You, Mr. Meyer!

To the Editor:

WHEN MACHINE DESIGN comes to my desk each month I am reminded of the pleasant contacts we have had at various engineering meetings, and have thought often of writing to congratulate you upon the fine magazine you are putting out, each number better than the last, if that is possible.

In the October number I find a directory of materials which I feel is one of the most valuable publications placed in the hands of manufacturers in a long time. You have put the machine industry under a very great debt of gratitude by this excellent compilation of the characteristics and sources of such a complete list of materials.

—F. H. MEYER
President, Leitelt Iron Works

Too Much Oil Defeats Purpose

To the Editor:

IN A ring oiled bearing, as most of us know, the oil is kept in a reservoir below the shaft. Rings pass over the shaft and the lower extremities dip into the oil, and since they are induced to turn by the shaft a small amount of oil is carried from the reservoir to the shaft by the ring.

Occasionally in an effort to maintain thorough lubrication, the reservoir has been filled almost up to the shaft. But instead of providing more adequate oiling this procedure defeats the very purpose of the oil rings. The higher the level of oil in the reservoir, the greater is the submerged portion of the ring and thus the resistance to its turning is increased. Hence, by raising the oil level less oil is actually carried to the shaft bearing.

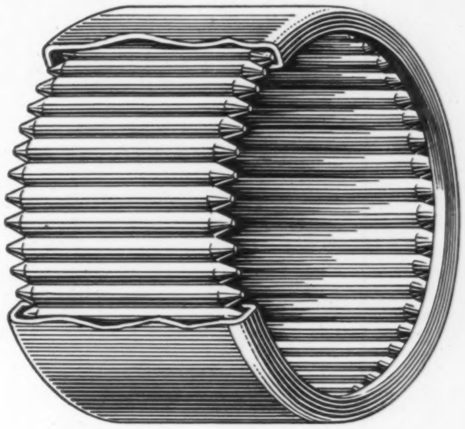
It is a good idea in the design of motors or other equipment which incorporate a ring-oiled bearing to provide a level gage or drain holes which will not permit the level to rise too high.

—J. E. H

Facts To Remember About

THE TORRINGTON NEEDLE BEARING

AN OUTSTANDING CONTRIBUTION TO MODERN PRODUCT DESIGN



THE DEVELOPMENT of the Torrington Needle Bearing has unquestionably been one of the biggest steps forward in the design of anti-friction bearings in many years. And the immediate acceptance of this new bearing by all branches of industry for many widely varied types of applications and products indicates that it not only fills a definite need but makes a marked contribution to modern product design.

An Entirely New Type Anti-Friction Bearing

As soon as it was announced, manufacturers everywhere realized the difference between the new Torrington Needle Bearing and the old type needle bearing. Here was a new bearing in every respect—a single compact unit made up of but two components—a full complement of small diameter needle rollers and a single retaining shell that served as the outer raceway.

It is small in size, light in weight, compact; it requires no more space than a plain bushing; it has a high radial load capacity; it is remarkably easy to handle and install when compared with the former type which comprised a series of loose rollers; its construction provides a simple and efficient method of lubrication because of the natural storage reservoir provided by the turned-in lip of the retaining shell, and which, in many applications, eliminates the necessity of end seals, oil rings or complicated lubricating systems.

It Is Surprisingly Low in Cost

With all these advantages one would instinctively think of a bearing much higher in price than the new Torrington Needle Bearing. Yet the price is surprisingly low—only a fraction of the cost of a ball bearing and only slightly more than a plain bushing.

However, the price is only one of the factors which contribute to *lower cost:* ease of installation speeds assembly; small size of the bearing simplifies design and housing structure—reducing amount and weight of material in surrounding members.

Other Features of the Torrington Needle Bearing

The service and performance records already established are an unusual testimony to the value of the Torrington Needle Bearing: its demonstrated ability to operate equally efficiently under both rotating and oscillating motion; the minimum of service attention which it requires due to its efficient lubrication; the low coefficients of both starting and running friction; the wide range of standard sizes available for all types of applications; a background of engineering, design and manufacturing experience gained through more than twenty-five years in the business of making ball bearings; a knowledge of steels and the "know how" to use them built up over a period of more than three-quarters of a century of making precision machine needles; all of these factors contribute to the making of the Torrington Needle Bearing. *There is no other bearing like it for quality or price.*

If you have not already obtained a copy of our catalog giving full information, we shall be glad to send it to you. Ask for *Catalog No. 9.* And we want you to know that the cooperation and experience of our engineering staff are at your disposal for consultation, or in the development of designs and layouts of applications.

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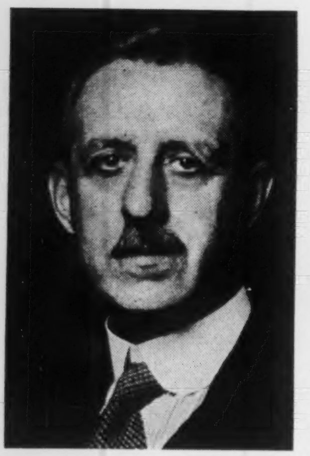
Torrington, Conn., U.S.A.
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

Men of Machines



GEORGE B. WATERHOUSE

GEORGE BOOKER WATERHOUSE, since 1922 professor of metallurgy at Massachusetts Institute of Technology, has been elected president of American Society for Metals.

Born in 1883 at Sheffield, England, Dr. Waterhouse came to America in 1903, two years after receiving his bachelor degree at the University of Sheffield, to pursue his studies in metallurgy at Columbia university. Upon completion of his thesis on nickel steels he was granted a degree of doctor of philosophy.

For 18 years prior to 1922 he was associated with Lackawanna Steel Co., Buffalo, as metallurgical and inspecting engineer. As chairman of the Iron Alloys committee of the Engineering Foundation, he has been co-author of a series of monographs published by that group.

• • •

AWARD of the 1938 John Fritz Gold medal, highest of American engineering honors, for "important contributions to the development of alloys for industrial uses," has been made to Dr. Paul Dyer Merica, director of research of the International Nickel Co.

Dr. Merica was born in Warsaw, Ind., in 1889. From 1904 to 1907 he studied at De Pauw university, which in 1934 conferred upon him his doctor of science degree. He had received his bachelor of arts degree from University of Wisconsin in 1909, and his Ph. D. degree from the University of Berlin in 1914.

Later he worked as research physicist in the U. S. Bureau of Standards until his appointment in 1919 as director of research of International Nickel Co.

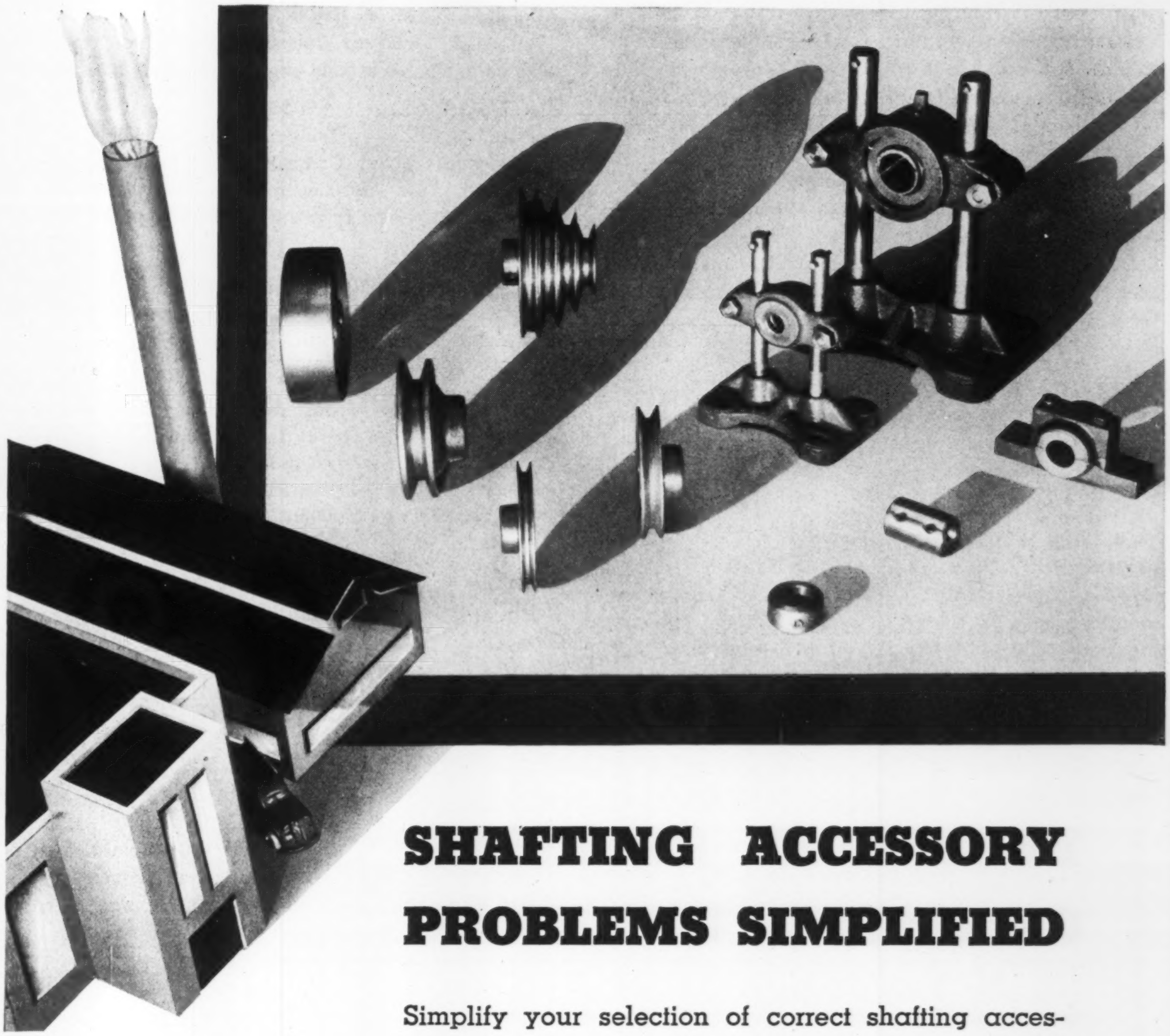
PAUL DYER MERICA

• • •

H. SIDNEY SMITH

TWO annual awards—the Samuel Wylie Miller medal of the American Welding society for meritorious contributions to the science and art of welding; and the James Turner Morehead medal of the International Acetylene association for "his vision, inspirational guidance and aggressive co-operation in the advancement of the acetylene industry"—have been made to H. Sidney Smith.

Mr. Smith, consulting engineer, Prest-O-Lite Co. Inc., New York, was born in Newark, England, and was educated as an electrical engineer at Nottingham university. He then became connected with various companies, and in 1901 began experimenting with the use of dissolved acetylene and also with oxyacetylene welding. The use of dissolved acetylene was sanctioned by the British Home Office largely as a result of these experiments.



SHAFTING ACCESSORY PROBLEMS SIMPLIFIED

Simplify your selection of correct shafting accessories — pillow blocks, adjustable shaft supports, crown face pulleys, grooved pulleys, collars, couplings, etc. — select them from our General Catalog which contains over 300 sizes and types to choose from — all carried in stock in 63 industrial centers of the country ready for immediate delivery.

Send for your free copy of our General Catalog, one section of which is devoted to complete specifications and list prices of Boston Gear Shafting accessories.

BOSTON
GEAR WORKS, INC.
NORTH QUINCY, MASSACHUSETTS

In 1910 Mr. Smith was elected president of the British Acetylene association. A year later he came to America and joined the Prest-O-Lite company at Indianapolis, becoming works manager in charge of all gas plants. He was made consulting engineer for Union Carbide Co. in 1918.

Elected president of the International Acetylene association in 1920. Mr. Smith is also a member of the American Society of Mechanical Engineers, American Society for Testing Materials and has for many years been a director and member of the executive committee of the American Welding Society.

◆ ◆ ◆

George J. Mead, vice president and chief engineer of the United Aircraft Corp., has been awarded the honorary degree of Doctor of Science by Trinity college, Hartford, Conn.

◆ ◆ ◆

Charles H. Jennings, engineer in charge of welding research for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is in England for a three months period in the capacity of welding engineering consultant with the English Electric Co. Mr. Jennings will resume his duties with Westinghouse about December first.

◆ ◆ ◆

Felix W. A. Knoll has been placed in charge of engineering and production activities of the Crusader Aircraft Corp., Glendale, Calif. He formerly was chief engineer of the Chieftain Aircraft Corp., Centerbrook, Conn.

◆ ◆ ◆

Stuart G. Baits, first vice president of the Hudson Motor Car Co., who began his career with the company in 1915 as a draftsman, has been made president of Hudson Motors of Canada.

◆ ◆ ◆

Howard W. Schultz, who has been assistant chief engineer of the Ohio Rubber Co., Willoughby, O., since 1930, has been promoted to the position of chief engineer.

◆ ◆ ◆

Ralph L. Wilson is now with Climax Molybdenum Co., Canton, O., as metallurgical engineer on development work. He was previously connected with the Timken Steel & Tube division, Timken Roller Bearing Co. as metallurgical engineer.

◆ ◆ ◆

L. C. Josephs, chief engineer of the Mack Mfg. Corp., has been elected vice president and a member of the board of directors.

◆ ◆ ◆

W. E. England has resigned as chief engineer of Willys-Overland Motors Inc.

◆ ◆ ◆

Frederick M. Ross has become vice president and chief engineer of the Esco Engineering Service Co., Toledo, O., which was purchased by the Regal Engine Co., now known as Regal Mfg. Co., Coldwater, Mich. Francis J. McGarry, founder of the Esco company, will be in charge of field engineering and sales.

◆ ◆ ◆

Philip E. Bliss, president of the Warner & Swasey Co., and Alexander C. Brown, first vice president of Cleveland Cliffs Iron Co., have been appointed to the board of trustees of Case School of Applied Science.

◆ ◆ ◆

A. C. Merritt, vice president, Allis Chalmers Mfg. Co., West Allis, Wis., was elected president of the Farm Equipment institute at the annual convention.

◆ ◆ ◆

Wayne Z. Friend has recently been added to the development and research staff of International Nickel Co. Inc. He will devote most of his time to technical service on corrosion resisting materials, particularly Monel, Nickel and Inconel.

◆ ◆ ◆

Stephen M. Jenks, formerly chief engineer, has been appointed assistant general superintendent of the Gary Works of Carnegie Illinois Steel Corp. George H. Bauer succeeds Mr. Jenks as chief engineer. Mr. Bauer has been at the Gary works since 1920, becoming assistant engineer in 1929 and assistant chief engineer in 1934. Siguard Landen replaces Mr. Bauer as assistant chief engineer.

◆ ◆ ◆

Prof. S. C. Hollister, formerly associate dean of the college of engineering of Cornell university, has been appointed dean, succeeding the late Herman Diederichs. Before joining the staff at Cornell on July 1, 1934, Dean Hollister was professor of structural engineering at Purdue university. He received his training at Washington State College and the University of Wisconsin.

◆ ◆ ◆

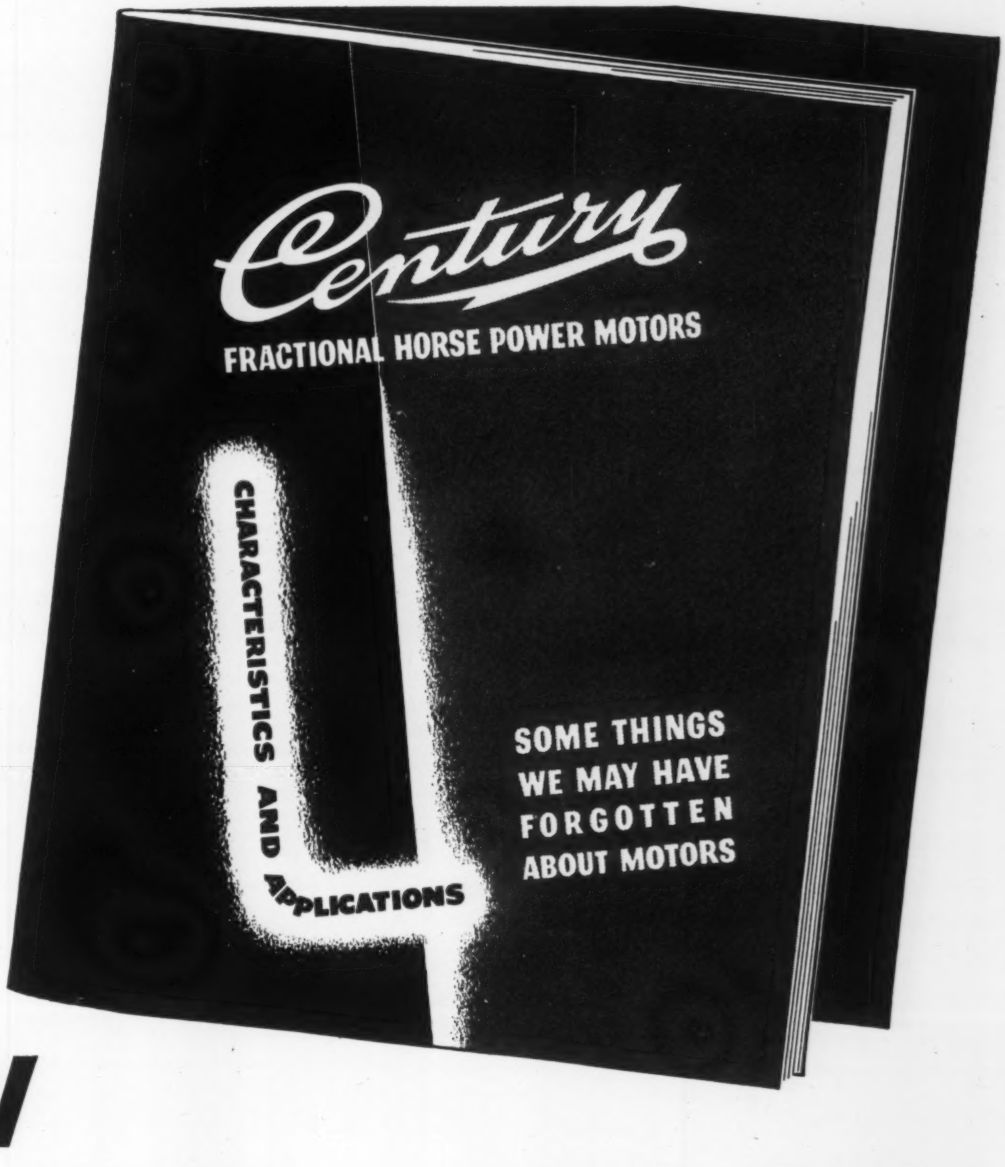
Pieter W. Schipper has sailed for Melbourne, Australia, to become chief engineer of the engine division of Commonwealth Aircraft Corp. Pty. Ltd. He was previously connected with Pratt & Whitney Aircraft division, United Aircraft Corp.

◆ ◆ ◆

Russell W. Ayres, who has been engaged in electric refrigerator design and research since 1925 when he became chief engineer of the refrigerator division of the Savage Arms Co., has been appointed chief engineer of the refrigerator division of the Stewart-Warner Corp., Chicago.

◆ ◆ ◆

Allan P. Stern, a graduate of Case School of Applied Science in June, 1937, received the Charles T. Main award of the American Society of Mechanical Engineers for a thesis entitled "The Influence of the Introduction of Labor-Saving Machinery Upon Employment in the United States."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FRACTIONAL HORSE POWER MOTORS
CHARACTERISTICS AND APPLICATIONS
SOME THINGS WE MAY HAVE FORGOTTEN ABOUT MOTORS

THIS BOOK *tells..*

HOW *to* SELECT *the* RIGHT MOTOR

This New 24-page book will be of real assistance to you . . . Here is presented in helpful form information concerning the electrical characteristics of all types of Fractional Horse Power Motors—and suggestions as to how they can be most effectively applied to meet the requirements of motor-driven machinery and appliances operating in normal or abnormal surroundings . . . Fully illustrated . . . Send for your copy, if you have not received it . . . **ASK FOR BULLETIN 1039-O . . .**

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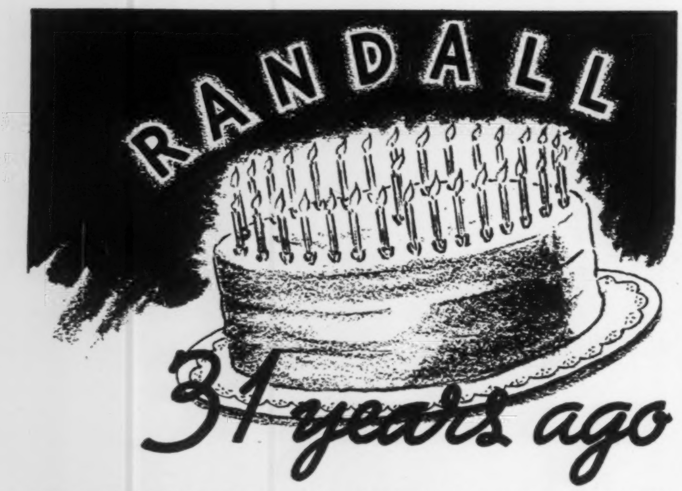

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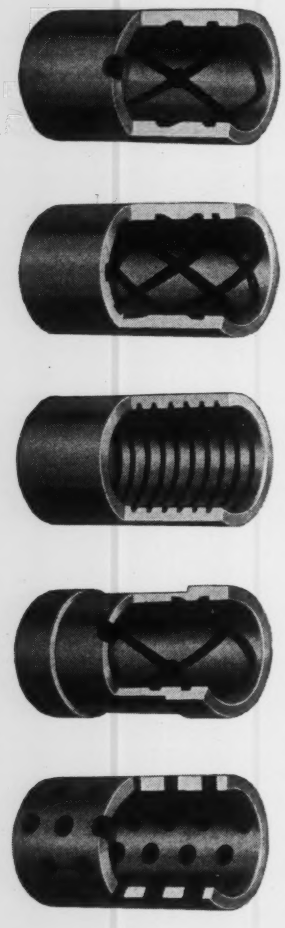

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Thirty - one years of steady progress and dependable service have put Randall in a preeminent position in the graphite bearing field. Today this name means dependable, trouble-free, long-lived bearings.

Randall Graphite Bronze Bearings for all types of machinery have taken the trouble out of operation in the field. They have a low coefficient of friction and will not seize or score the shaft. The graphite, an exclusive Randall formula, will not crumble or soften. It wears evenly with the bronze and neither oil nor water will cause it to recede below the surface.

Randall Bushings are furnished in any required size or style and can be reamed, broached or diamond bored.

Whatever your bearing problems, Randall already has the answer. Our engineers will be glad to assist you without any obligation whatever.

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Dept. 1212 609 W. Lake St., Chicago, Ill.

Noteworthy Patents

A SPEED reducing transmission utilizing "streams" of hardened steel balls as its power transferring medium, has been invented by Preston Whitcomb of Kenmore, N. Y. The patent—No. 2,082,433—is assigned to Manning, Maxwell & Moore Inc., New York. While its basic principles have possibilities in many directions, the system is particularly adapted to compact hoists, shown in *Fig.* 1.

This design embodies a hollow revolving drum with end plates which serve as supports for the hoist. The left end plate carries a capped outboard bearing for a central shaft, while to the right end plate is bolted a flange-mounted motor. The central shaft, an extension of the motor shaft, has a section on which is cut a worm whose thread or channel is shaped to fit the contour of the balls.

Mounted in each of the end plates and fixed against sliding or rotating, are guide sleeve plugs comprising central sleeve-like portions terminating in disk end members having concave inner faces. The central shaft rotates within a stationary sleeve, only the ends of which can be seen in the drawing. This sleeve has five longitudinal slots along which the five rows of balls are propelled (pumped, so to speak) by the action of the worm. Surrounding this is a cylindrical member called the intermediate worm. Its bore has a single right-hand thread of 4½ inches lead, shaped to fit the balls, while its periphery is provided with a right-hand thread of the same pitch. The ends of this cylinder are channeled for ball bearing rings. The opposite rings of these bearings are mounted in the inner, flat faces of rings whose outer semicircular faces are fixed opposite the concave flanges

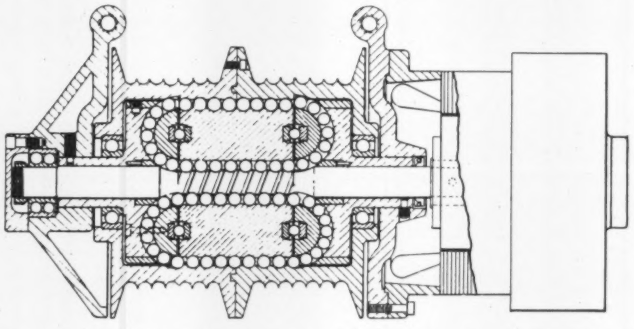
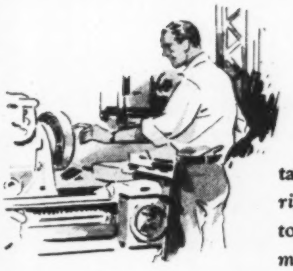


Fig. 1—*Speed reduction results when five streams of balls, propelled by worm, act on worm threads*

after all...

IS MACHINERY A GOOD THING



ONE THING SURE, the world of today wasn't made by hand . . . it was made by machinery. If we had fought this thing out just with our hands, the apes would have licked us long ago.

In the beginning the only animal in the jungle who had sense enough to seize and to use the materials and forces around him was Man. And with this one slight edge he has turned the rest of them into meat for his table, leather for his feet, and circuses for his amusement.

It PAYS to think! It pays to invent! It pays to seek the newer and better way! Don't ever do *anything* with your own two hands that you can do better with your BRAIN!

◆ ◆ ◆

We hear a lot these days about the *evils* of mechanization. Some say machines throw people out of work . . . that, because of machines, millions are unemployed . . . that we are being ground to death by the Frankenstein monster of steel which we, ourselves, have built.

If this is true, then we ought to get out our sledge hammers and smash all this machinery to pieces.

But before we wreck it, let's look at the facts . . . is or is not machinery a good thing?

The job of machinery is to end drudgery, and it's making headway . . . particularly here in America where there is less backache than anywhere else in the world. If you doubt it, just take a trip to Europe. Machinery does not enslave . . . it emancipates! It doesn't empty pockets and stomachs and hearts . . . it *fills them!*

It releases women from soapsuds and washtubs and makes better sweethearts, sisters, daughters, wives and mothers out of them. It has lifted the farmer off a horse and put him on a tractor. And, as for the shopman, it has taught him how to drill a thousand holes *right*, in less time than it used to take him to drill one hole *wrong . . . and to get more money for it.*

"But how about the men that these drill-presses displace?" Don't say "displace" . . . say "*promote.*" Machinery has lifted these men into better jobs. They themselves will tell you so. They'll go even further . . . they'll tell you that, before machinery, anybody who would have dared to suggest a shorter day, a shorter hour week, and a bigger wage, would have been plain crazy.

The fact is that machinery has at last made it possible for the forgotten man to begin thinking in terms of daylight and fresh air and sunshine and LEISURE.

Is or is not that a bad thing?

Without machinery, there could be no volume. Without volume, things would cost more and they wouldn't be anything like as good. Without better goods for less money, only the favored *few* could have modern homes and live modern, full-lunged lives.

This means that without better goods for less money there could be no mass markets . . . meaning no mass employment . . . meaning PERMANENT DEPRESSION! Would we like to see THAT happen?

◆ ◆ ◆

No . . . machinery is NOT a bad thing! It is the best of man-made GOOD things!

We are on our way . . . marching onward and upward to the music of whirring wheels. And LINK-BELT is furnishing its share of the music.

In most machinery, today, LINK-BELT engineering and LINK-BELT manufacturing are playing an increasingly vital and important part.

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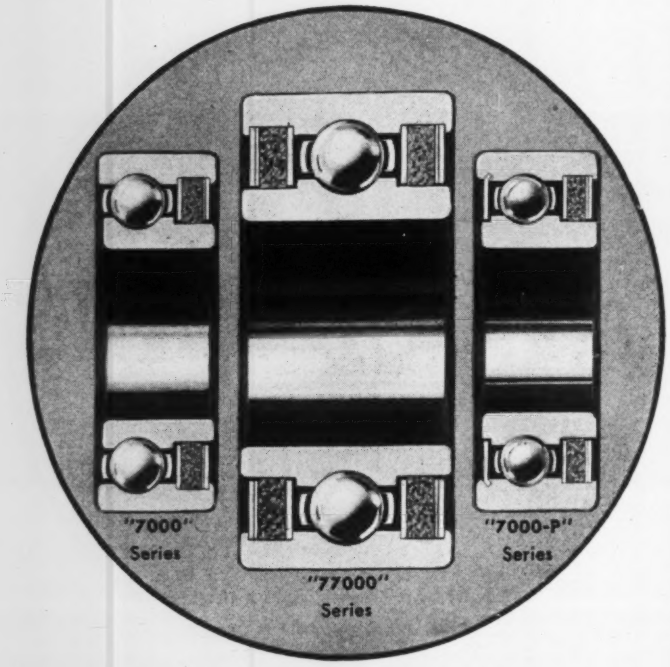

SELF-SEALED

Norma-Hoffmann "GreaSeal" Felt-Protected PRECISION Ball Bearings have the following outstanding advantages:
Thick, closely-fitting felts between removable plates, forming an effective labyrinth against recessed inner ring.
FELT SEAL REMOVABLE in its entirety, for inspection, cleaning, or renewal of grease.
Wide inner and outer rings, with maximum contact on shaft and housing, make inserts in housing unnecessary and militate against slippage, looseness and escape of lubricant past outer ring.
Felt seal entirely within confines of both rings; therefore not exposed to injury.
Seal construction avoids race distortion, assuring dimensional exactness and quiet running.
Grease capacity ample for long periods.

Write for the Catalog. Let our engineers work with yours.

NORMA-HOFFMANN
PACKED WITH
STABILITY-TESTED GREASE
IN DISTINCTIVE
ALUMINUM FOIL
PROTECTIVE WRAPPING
PRECISION BEARINGS

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PRECISION BEARINGS
BALL, ROLLER AND THRUST
NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U. S. A.

of the disk end members. Segmental thrust plates, curved to fit the space, are secured to the concave faces of the end members, these being spaced to form five ball channels at each end.

Surrounding the intermediate worm is another fixed sleeve similar to that around the central shaft and like it having five longitudinal slots along which the rows of balls are propelled. The ends of this sleeve show just beyond the outer rows of balls. The slots of this outer sleeve complete the oblong pathways or loops followed by the five rows of balls.

Shell Made in Two Parts

The outer revolving shell, either a grooved hoisting drum as illustrated or a smooth-faced power pulley, is made in two parts bolted together. It runs on ball bearings in its outer flanged ends and the central portion of its bore has a single thread left-hand worm of 18-inch lead, with contour to fit the balls.

When the motor is started, the worm on the central shaft sets the five loops of balls flowing in a clockwise direction along their slots in the inner fixed sleeve. Impinging against the internal thread of the intermediate worm, they cause it to revolve in a direction opposite to that of the central shaft and at reduced speed.

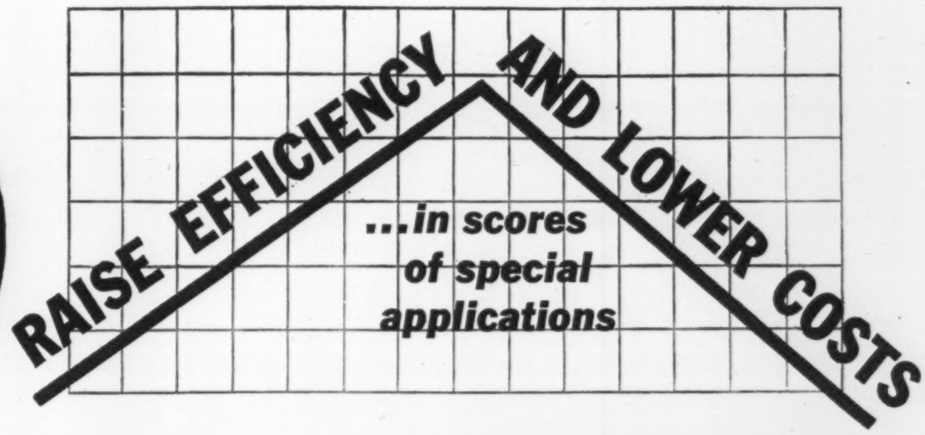
Passing around the curved end channels, the balls enter the slots in the outer fixed sleeve along which they are in turn propelled by the thread on the outside of the intermediate worm. Impinging against the internal worm of the outside shell, or winding drum, they cause it to revolve in a direction opposite to that of the intermediate worm, with reduction in speed of 36 to 1 (as compared to the central shaft) when the before-mentioned pitches of worms are employed.

Resilience Defeats Vibration

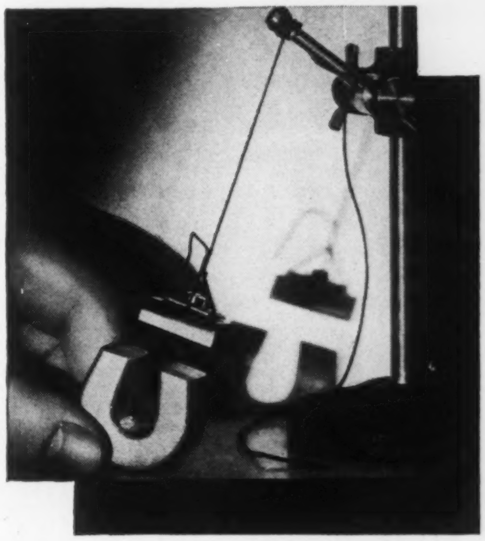
WHEN a centrifugal separator is started up under load it passes through a critical speed at which it vibrates. Then as its speed increases it arrives at a smoother condition of operation, unless its load is badly unbalanced.

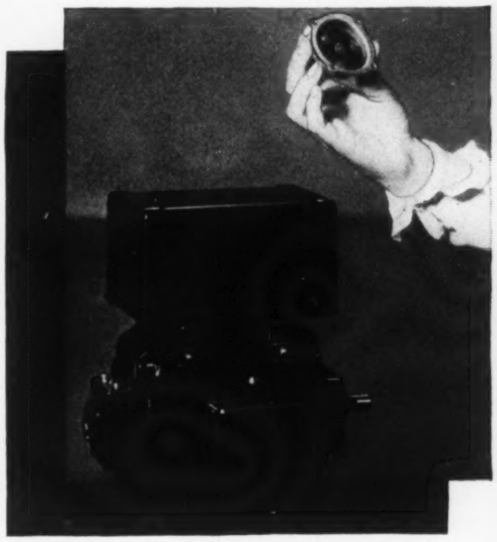
Vibration at critical speed is caused by conflict between forces tending to compel the spindle to revolve about its own axis and other forces tending to make the spindle rotate about an axis passing through the center of gravity of the entire rotating mass, including spindle, basket and load. So long as one set of forces or the other is in definite control of the situation, a smooth running condition is maintained, but when the two are more nearly equal with neither in definite control, then an unstable running condition exists and excessive vibration occurs. This problem is exceptionally

HIGH NICKEL ALLOYS


RAISE EFFICIENCY
AND LOWER COSTS
...in scores of special applications

HIGH MAGNETIC QUALITIES... The magnet pictured here is small, but extraordinarily powerful—capable of lifting 60 times its own weight. This particular type, made of a new alloy rich in Nickel, is used for damping magnets in the polyphase meters of the Duncan Electric Co., Lafayette, Ind. Not only do these alloys of high Nickel content effect substantial savings in weight (in this case 80%) but they also have a higher permanency factor than other commercially available magnetic materials and are practically immune to the effects of magnetic disturbances caused by short circuits and lightning. Manufacturers who employ magnetic materials in their products will find these new alloys of Nickel profitable to investigate.





HIGH AND LOW EXPANSION PROPERTIES...

One of the most valuable metallurgical developments in recent years has been the production of thermostatic metals for operating automatic control devices. Pictured here is one employing a bi-metallic disc made of two alloys of Nickel, one having a high degree of expansion and the other low expansion properties. It guards the Westinghouse refrigerator motor, disconnecting it when it gets too hot and reconnecting it when it cools off. Principle upon which these thermostatic metals operate is based on a differential in the expansion properties of the two constituent metals. Changes in temperature cause them to deflect and this in turn acts on the control device. Alloys of Nickel can be produced for applications requiring extremely low expansions as well as for service where specific expansion characteristics may or may not be low.

IMPROVED PERMEABILITY... When you make your long distance telephone call or send a cable, a highly magnetic Nickel-Iron alloy of improved permeability containing up to 80% Nickel helps to deliver your message. Impulses sent over long circuits have a tendency to drag their "tails" behind them, upon which succeeding impulses tread. But through the use of loading coils made of a high Nickel alloy, and spaced at regular intervals along the circuit, transmission is speeded up and your words made intelligible. The high magnetic permeability of these alloys is also depended upon to increase the efficiency of submarine cables and various parts of radio, telephonic and telegraphic installations. We invite consultation on the use of the Nickel alloys in your equipment.

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.

BACKGROUND

Any product to be successful over a term of years must have back of it soundness of design and adequate service.

The Leland Electric Company meets those requirements in fullest measure. Therein lies the success of its products in the field of small motor manufacturing throughout the world.

Whatever your motor requirement may be, it will pay you to consider the Leland.

THE LELAND ELECTRIC COMPANY

Canadian Address: Toronto

DAYTON, OHIO, U. S. A.

Cable Address "Lelect"

troublesome in small machines, particularly where high speeds are involved.

Patent No. 2,087,848, issued to John F. Tholl and assigned to the American Tool & Machine Co., Hyde Park, Mass., covers a practical solution. The Tholl centrifuge, depicted by *Fig.* 3, is driven by a V-belt, the pulley being located at the lower edge of a cup surrounding the spindle bearing structure. This cup is a downward extension of the hub to which the basket is bolted. The bearing structure comprises a sealed casing of stepped formation arranged for pressure lubrication. This is mounted and centered upon its base support by means of a resilient bushing — indicated on the drawing by heavy section lines — of rubber or similar material. The bearing unit is held down firmly on the resilient bushing by action of a strong conical spring compressed between the base of the machine and a nut and washer on a short stud which is screwed into the lower end of the bearing unit.

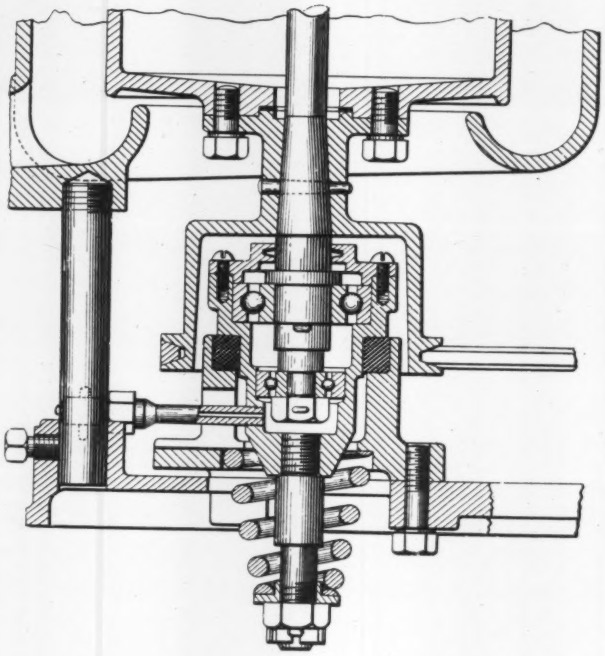
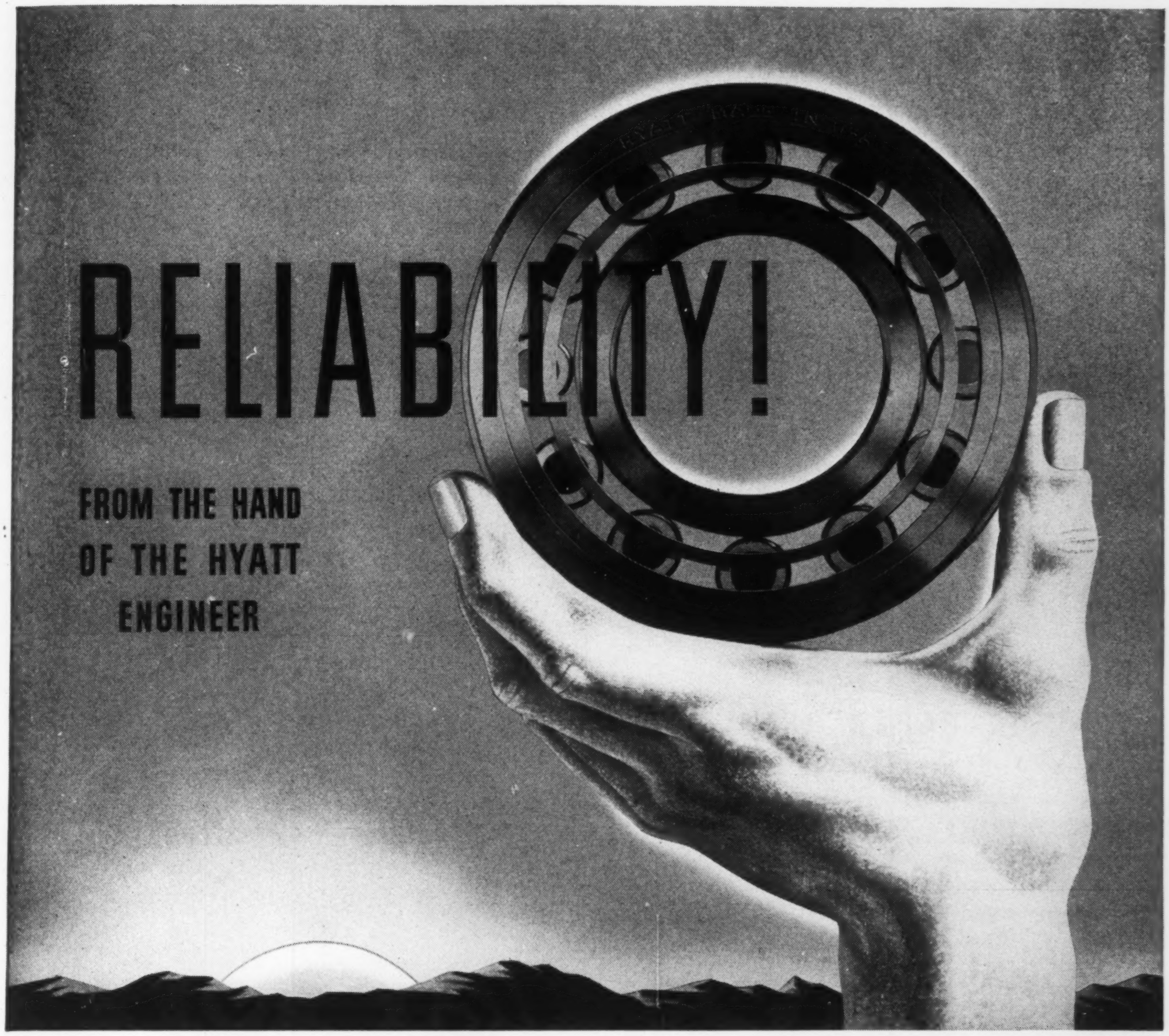


Fig. 3—Floating bearing support insures smooth centrifugal action even with unbalanced load

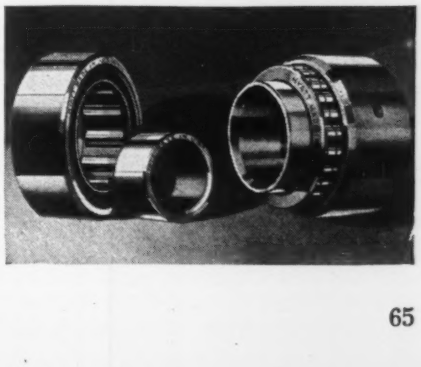
This arrangement normally centers the spindle and holds it centered with a considerable degree of firmness. However, it has enough resiliency to allow the spindle a certain amount of "float" while it is passing through its critical speed. This causes the machine to operate smoothly while the basket assembly is rotating around the center of mass rather than around the centerline of the spindle, even when the load in the basket is definitely out of balance.


RELIABILITY!
FROM THE HAND OF THE HYATT ENGINEER

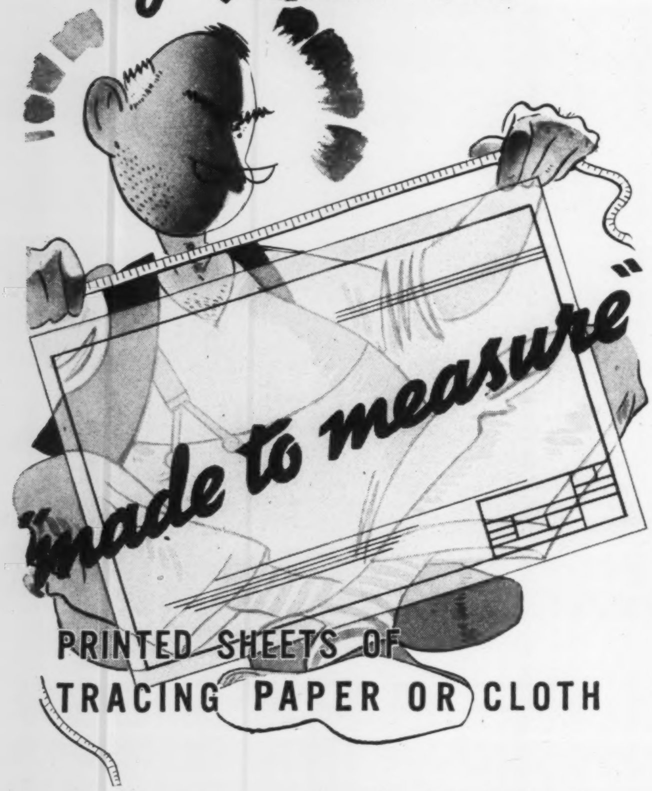
RELIABILITY, in the machines you build or use, starts at the bearing points! Use Hyatt Roller Bearings with complete assurance that they will give you longer life under heavy loads, keep related parts in alignment, resist wear, minimize maintenance, and transmit the full measure of power. Not because of any secret formulae, but because of the advanced design by Hyatt engineers and precision manufacture of Hyatt craftsmen.

Evidence of Hyatt reliability is found everywhere in industry... wherever shafts, gears and wheels turn... in mill and factory, on the farm, on railways and highways. Certainly these bearings have a tough life, but, fortified by nearly fifty years' experience in building better bearings, Hyatts definitely have proved they can take it. Hyatt Bearings Division, General Motors Corporation, P. O. Box 476, Newark, New Jersey.

HYATT
ROLLER BEARINGS



A New Booklet Of Ideas On



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Assets to a Bookcase

Thermodynamics

By Stanton E. Winston; published by American Technical society, Chicago; available through MACHINE DESIGN *for* $1.50, *postpaid.*

Designers concerned with steam power plant equipment, diesel and other internal combustion engines, refrigeration machinery and air conditioning apparatus work in the dark if they try to carry on without knowledge of the fundamental principles of thermodynamics. Forces involved are too dangerous to be dealt with by rule-of-thumb design methods or by guess work.

Into this 178-page book, Mr. Winston, who is associate professor of mechanical engineering at Armour Institute of Technology, has succeeded in presenting in relatively simple manner the general principles of engineering thermodynamics which are basic to those fields mentioned in the first paragraph of this review. In this successful effort to attain simplicity, the more complicated processes have been avoided and in keeping with this idea the calculus has not been resorted to. Generous use is made, however, of practically useful formulas.

Each of the five chapters is followed by a set of problems, to which answers are given.

□ □ □

Theory of Lubrication

By Mayo D. Hersey; published by John Wiley & Sons Inc., New York; available through MACHINE DESIGN *for* $2.50, *postpaid.*

Based on a series of public lectures delivered by the author at Brown university, Yale university and Massachusetts Institute of Technology, this book covers the scientific background as well as the mechanics of modern lubrication.

Mr. Hersey, research associate in engineering at Brown university, has prepared the text primarily for engineers, investigators, physicists and teachers of engineering. In view of the fact that the basic lectures were planned to a large extent to help engineers of leading New England industries in the practical solution of their everyday lubrication problems, the book can well be recommended to thoughtful designers of machinery. Some familiarity with the calculus will be helpful, but it is by no means essential to effective perusal of this book.

While the text has been "boiled down" to give con-

Less Scuffing
and 12½¢ Less Cost

EVERYTHING IDENTICAL but the steel. *But the gears at the right made of a special grade of U·S·S Carilloy Alloy Steel—will scuff less, run more quietly, and cost 12½c less per set. A typical result of close cooperation between our metallurgists and yours.*

...both obtained with one change in Steel

TO make a cheaper set of gears is not difficult . . . if quality can be sacrificed.

To make a better set of gears is no greater problem . . . if cost can be ignored.

But to make a better *and* cheaper set of gears — gears which will run more quietly, scuff less and save 12½c per set in material cost — is an accomplishment of which any two metallurgists can well be proud.

This is the result of a cooperative study, extending over a six weeks period, by a metallurgist from Carnegie-Illinois and a metallurgist of a well-known automobile manufacturer. The first was thoroughly familiar with alloy steels and the limitless combinations of analyses and heat treatments. The second knew the requirements of their 1938 models and the advantages of their plant facilities. Working together, they could coordinate and pool their knowledge. They could achieve a result that neither could achieve alone.

Our aim is to give you outstanding metallurgical cooperation . . . and the finest alloy steels possible.

U·S·S CARILLOY ALLOY STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*   United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

WILCO OFFERS 2 WAYS of Cutting Silver Contact Costs!

1

Wilco Inlay and Overlay is available in sheet and strip form or we can furnish stamped parts to your blueprint specifications.

2

Wilco silver steel laminated contacts are made in a variety of diameters—we are equipped to do projection welding for you—send for special bulletin.

● With Wilco laminated contact materials it is possible to reduce the amount of precious metal to a minimum. In addition to actual savings on contact costs, many manufacturers have been able to reduce assembly costs. Here's why. With Wilco Inlay and Overlay materials it is possible to design specially shaped contacts that become an integral part of the contact mechanism—thus reducing parts. Wilco silver steel laminated contacts eliminate riveting because they are permanently welded to their supporting arm. If you will send blueprints and indicate the quantity, we will be glad to furnish a quotation.

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Refiners and Workers of Platinum, Gold and Silver · Precious Metal Contacts · Wilco Thermometals (*Thermostatic Bi-metals*)
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densed treatment with minimum of detail, each one of the six chapters is followed by a notable and detailed list of references which readily will enable the reader to delve into the subject to any depth desired. Chapter I alone carries 138 of these references.

□ □ □

Motor and Control Applications

By George H. Hall; published by the McGraw-Hill Book Co., New York; available through MACHINE DESIGN *for* $3.00, *postpaid.*

With ever-growing applications of electrical drive and control in machinery, mechánical and electrical engineering have drawn close together as far as machine design is concerned. No longer does the engineering department of any progressive company expect its electrical maintenance men to solve electrification problems involved in new designs. Instead, competent, specialized electrical engineering talent is applied to these problems.

In order to work intelligently with electrical engineers, either of the company's own staff or those representing manufacturers of electrical equipment, a machine designer should be reasonably well informed on recent developments bearing on machinery electrification. However, unless he himself is a trained electrical engineer, he should be wary of drawing up important electrical specifications without professional advice. Even electrical engineers welcome the help of consulting talent such as that now freely available from the electrical industry.

The foregoing statements should make it clear that Mr. Hall's book is recommended to machine designers, not as one to tell them all about "how to be their own electricians," but rather as one which will help them greatly in working with electrical engineers in the development of designs which are just as correct electrically as they are mechanically. The author states in his preface that no attempt is made in the book to deal with details of motor design. Rather, its object is to present as concisely as possible the characteristics obtainable from various types of motors and performance obtainable from them by selection of suitable control.

Of the twenty-five chapters, the following are of particular interest to mechanical engineers and designers: Determination of Machine Requirements; Protective Control Devices; Stopping Devices; Enclosures; Shaftless Motors; Integral Speed Reducers; and Connecting the Motor to Its Work. Special chapters are devoted to electrical applications to machine tools, woodworking machinery, fans and blowers, pumps and compressors and hoists and cranes. There are 167 illustrations and a useful index. Higher mathematics is avoided.

Now – A Flexible Coupling that's

FULL
FLOATING

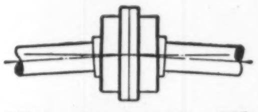
The ONLY Coupling on the Market that Takes Care of ALL FOUR Drive Conditions Without Increasing Bearing Loads!

Here's a flexible coupling that's *more* than merely a coupling. Most couplings on the market take care of two or possibly three direct drive conditions and only when present to a *slight* degree. The RYBECK coupling is of full-floating, semi-universal joint design — *flexible in all directions.* It takes care of ALL FOUR drive conditions even when present to an *excessive* degree and without increasing bearing loads.

Why be satisfied with a coupling that only *partially* solves your direct drive problem when you can get a RYBECK full-floating coupling at no greater cost? Time-tested and manufactured by the T. L. Smith Company, a nationally known leader in its field for the past 37 years. Before you specify—investigate this better coupling. Write for bulletin.

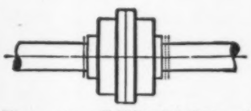
The T. L. SMITH CO., 2818 N. 32nd St., Milwaukee, Wis.

1



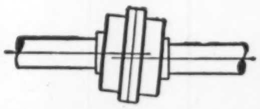
Allows for excessive ANGULAR misalignment of shafts.

3



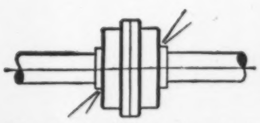
Permits END PLAY of shafts with minimum resistance.

2



Allows for excessive OFFSET misalignment between shafts.

4

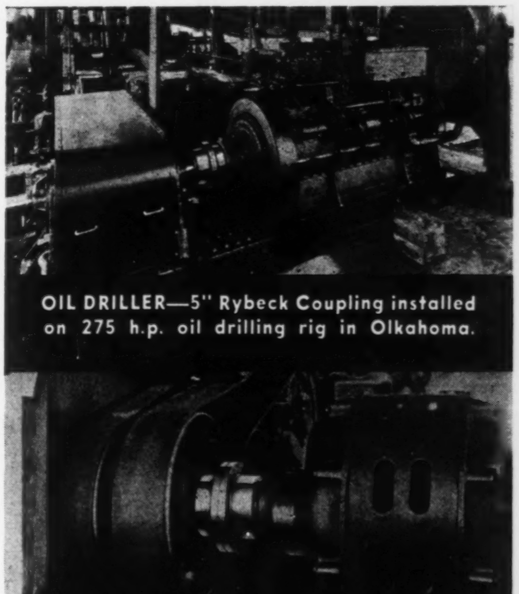


Absorbs and Smoothens out SHOCKS and Vibrations in the drive.

RYBECK

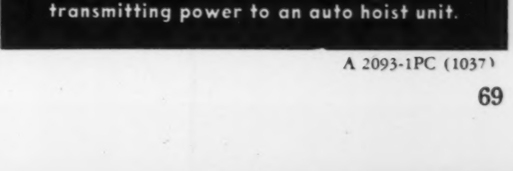
TRADE MARK

FLEXIBLE COUPLING



OIL DRILLER—5" Rybeck Coupling installed on 275 h.p. oil drilling rig in Olkahoma.

LUMBER MILL—Rybeck Coupling giving heavy duty service in a large midwest lumber mill.



HOIST—A 2¼" Rybeck Coupling used in transmitting power to an auto hoist unit.

A 2093-1PC (1037)

Split Seconds Are Magnified to Minutes

in the new *Super-fast* Camera

powered by a

BODINE MOTOR

As many as 2500 pictures per second can be taken with the latest Western Electric high speed camera—used to analyze or diagnose trouble in high speed machinery. To drive the film and the rotating glass prism for this camera, a Bodine constant speed synchronous motor was chosen.

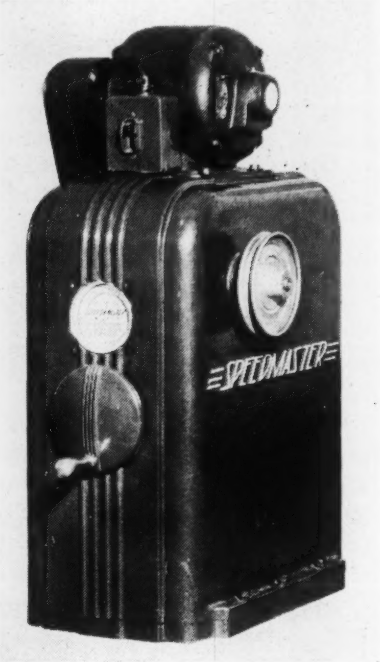
This is but one of many high quality, precision-built instruments which are driven by Bodine motors. The Bodine line consists of fractional horsepower motors of almost every known type, from 1/2000 to 1/6 horsepower, to fit almost any load. However, where requirements are very special, specially engineered Bodine motors can be built. Consult Bodine on your next motor drive. Bodine Electric Company, 2258 W. Ohio St., Chicago, Ill.

BODINE
BODINE
FRACTIONAL H. P.
MOTORS
ENGINEERED FOR YOUR PRODUCT

NEW *Materials and Parts*

Variable Speed Drive Announced

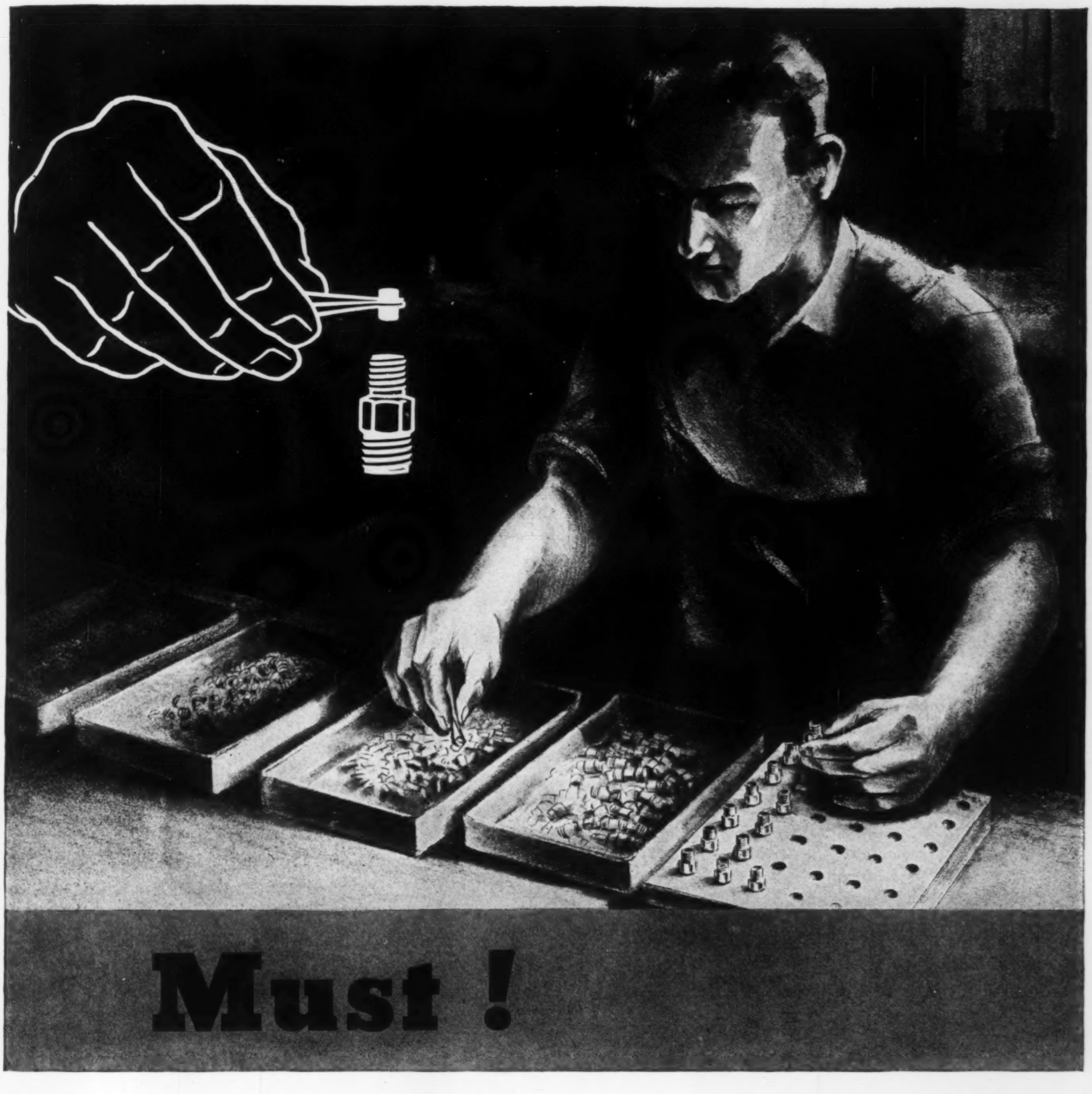
SPEED range as great as 45 to 1 is accomplished in a variable speed transmission known as the 'Speedmaster'', recently placed on the market by The Speedmaster Co., 1303 Washington avenue south, Minneapolis. Standard V belts are employed, running over adjustable Bakelite pulleys. A handwheel on the cabinet controls a toggle lever which regulates the effective pulley diameter for changing speeds. A speed indicator is built-in to the unit and the dial is placed in a convenient position. The unit shown in the accompanying illustration has a small motor mounted on the top of the transmission case. However, the motor may be mounted in various positions on the housing, or the entire unit may be used to serve as a base or leg of the machine it drives. The transmission is available in several sizes.



V-belts running over adjustable Bakelite pulleys are used for speed variation in this transmission. Speed indicator and speed regulating handwheel are placed conveniently on case

Universal Joints for Severe Service

DESIGNED for heavy duty intermittent service, low RPM in continuous service or hand-operated systems, a compact universal joint, 8700 series, has been announced by New England Auto Products Corp., Pottstown, Pa. Hub yokes are made from steel forgings and center blocks and pins of hardened steel. In-



● This tiny pellet of felt! . . . Its accurate cutting and its texture MUST exactly conform to rigid specifications. ● In eliminating frozen bearings . . . reducing shutdowns for machine repairs . . . oil filtering in metered-lubrication feedlines is one of a thousand delicate operations where FELT serves best. If—it is supplied out of the full knowledge, the skill *and* the facilities which true felt specialization demands! Write for sample and application chart.

BOOTH FELT COMPANY, INC. • ESTABLISHED 1905 • 444 NINETEENTH STREET, BROOKLYN, N. Y.

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897

Wagner Motors
Are Outstanding
For Their
Good Performance and
Dependability

Motor dependability means the ability of the motor to provide unfailing service; good performance means the ability of the motor to satisfactorily and efficiently meet the load requirements of its application. Because Wagner motors possess these qualities as demonstrated on hundreds-of-thousands of motor applications, they have won the approval of users everywhere.

These qualities in Wagner motors are not accidents, but are specially built into them . . . built into Wagner motors by better design, better materials and better methods of manufacture . . . Yes, at a slightly higher cost to the motor manufacturer — but Wagner policy forbids any economy which is destined to result in a higher cost-per-year service to the motor user. Weigh these factors when considering your next motor purchases. Wagner motor bulletins will be sent upon request.

MM237-2J

Wagner Electric Corporation
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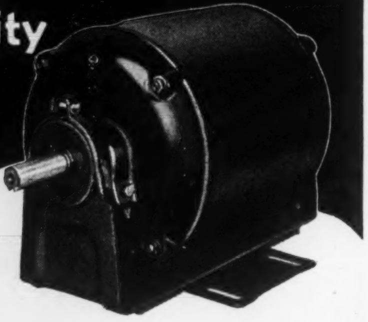
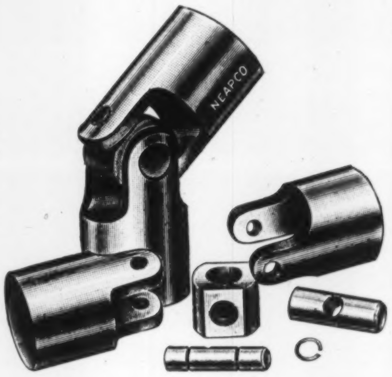
MOTORS • FANS • TRANSFORMERS • BRAKES



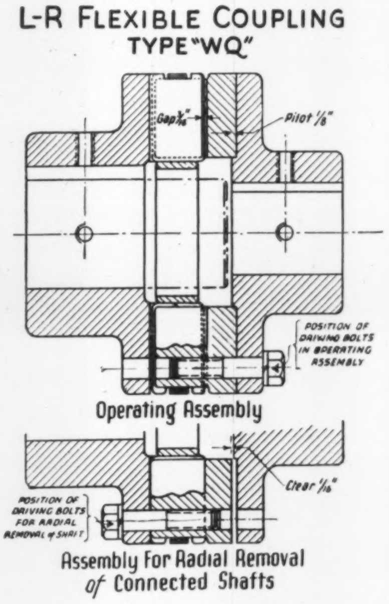
ternal locking ring makes assembly or disassembly a matter of a few seconds. Joint will operate up to an angularity of 45 degrees. Diameter of hubs is 1¾ inches and overall length of joint is 5¼ inches. This type of universal joint is made in sizes up to 3-inch diameter hubs and will transmit a torque of 40,000 inch pounds.



Internal locking ring in universal joint makes assembly or disassembly a matter of a few seconds

Coupling Easily Detached

AN ADDITION to the line of flexible couplings made by the Lovejoy Flexible Coupling Co., 5018 West Lake street, Chicago, has been announced and is known as the L-R type WQ. The coupling is so designed that either half may be rotated independently of the other by removing a few screws. This independent rotation is valuable when the coupling is used on gasoline, steam or diesel engines as it allows easy timing of the engine. Three types of cushions are employed with the new coupling. Metalflex, a long wearing, brake lining material, used where heavy loads develop. Leather load cushions for use on sustained loads with considerable misalign-


L-R FLEXIBLE COUPLING
TYPE "WQ"
Gap 3/16"
Pilot 1/8"
POSITION OF DRIVING BOLTS IN OPERATING ASSEMBLY
Operating Assembly
Clear 1/16"
POSITION OF DRIVING BOLTS FOR RADIAL REMOVAL of SHAFT
Assembly For Radial Removal of Connected Shafts

Three different cushioning materials are available with this coupling for various types of service

★ By Your Command ★

A. M. Wahl's "General Considerations in Designing Mechanical Springs", originally published in MACHINE DESIGN in 1930 and reprinted in 1931, has been in continuous demand for the past seven years. Long out of print, we are now acceding to popular demand to have the author completely revise the data in keeping with the past seven years' developments in spring design. The new series will be published in four parts, beginning next month.

A. M. Wahl, Research Engineer, Westinghouse Research Laboratories, in addition to being author of "General Considerations in Designing Mechanical Springs" and other articles on the same subject, has prepared numerous technical articles on pipe bends, stress analysis of machine parts, stress concentration and photoelasticity. He is co-author of a book on "Plasticity" and collaborated in revising the "Machine Elements" section of Marks' Mechanical Engineers Handbook, 1930 Edition. Dr. Wahl received his B. S. degree from Iowa State College and his PHD degree from the University of Pittsburgh. He has been a member of the Westinghouse Research staff since completion of his engineering and design school training in 1926, specializing in research work on mechanical and electrical engineering problems arising in connection with the design of electrical machinery. He is a member of the American Society of Mechanical Engineers.

"General Considerations in Designing Mechanical Springs"

Information provided in this four-part series will assist the designer in his spring problems and will enable him to make preliminary calculations based on his particular application.

By determining spring requirements more accurately in advance of consultation with spring manufacturers, much greater success will be achieved in their use.

The complete field of helical and torsional spring design will be discussed in this series. Contents will be:

Part I—Rational Method for Helical Spring Design.
Part II—Stresses Employed in Practice.
Part III—Springs of Square and Rectangular Wire.
Part IV—Calculating Torsional and Spiral Springs.

Formulas and complete information on their application will make this series a valuable addition to handbook and engineering data files. Its use will reduce the number of spring failures due to "guess-work". Spring manufacturers will be in a much better position to supply exactly the required spring with assurance. Development time will be greatly reduced because of carefully and accurately worked out specifications.

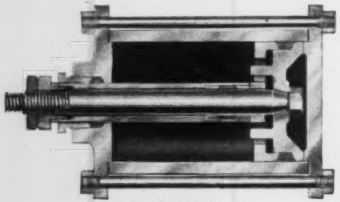
We are pleased to cooperate with those men who are delegated with responsibility for machine design, by providing this completely revised series of articles on spring design by Dr. Wahl. Watch for the first part in the January issue.

MACHINE DESIGN

PARTS . . . MATERIALS . . . METHODS . . . FINISHES

CLEVELAND, OHIO

● Simple Outside Adjustment *maintains high efficiency* Air Cylinder Operation

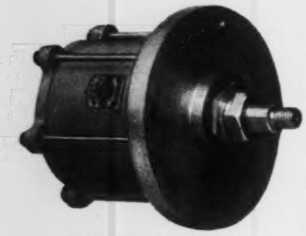


Sectional view

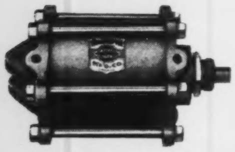
Hannifin "Leak-proof" Air Cylinder construction has the simplest outside adjustment of the piston packing. Maximum utilization of air power, without leakage, can be consistently obtained, for the original high-efficiency piston seal is easily maintained throughout the entire life of the packing.

Correct adjustment of the soft, graphite treated piston packing is made, whenever required, from the outside of the cylinder without disturbing any other parts. The adjusting nut and tube are an integral assembly, locked in position on the threaded end of the piston rod. There can be no end play as the packing wears. Adjustment requires only loosening the lock nut and turning the adjusting tube.

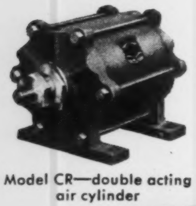
Improved air cylinder performance is available for any type of use. Hannifin "Leak-proof" Air Cylinders are built in a complete range of standard types and mountings, sizes 1½ to 16 in. diameter, for any length stroke. Larger sizes built to order. Single acting and double acting types, with air cushion at either or both ends if required. Write for Bulletin 34-MD with complete specifications.



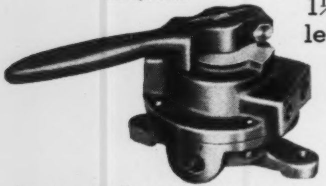
Model JR—double acting air cylinder



Model BR—double acting air cylinder



Model CR—double acting air cylinder



Hannifin "Pack-Less" Air Control Valves available in all types for positive control of air operated equipment.

HANNIFIN MANUFACTURING COMPANY

Engineers • Designers • Manufacturers
Pneumatic and Hydraulic Production Tool Equipment

621-631 SOUTH KOLMAR AVENUE • CHICAGO, ILLINOIS

HANNIFIN
IMPROVED AIR CYLINDERS

ment and multiflex cushions, a rubber duck fabric, employed where loads fluctuate and maximum resiliency is important. L-R type WQ couplings are made with bores from 1½ to 14 inches.

Oiler Gives Measured Amount

ACCURATELY measured feed of oil at all times is assured in the predetermined feed machine oiler brought out by M-B Products, 130 E. Larned street, Detroit. The oiler will continue indefinitely to allow a certain predetermined amount of oil to reach the bearings of a machine. Oil capacity is sufficient for an eight hour period, whether oils of 150 to 250 viscosity are used or lighter oils of 90 to 100 viscosity. The oiler is built entirely of steel except for glass ports effectively guarded by the metal. It is available in two sizes, of 1½ and 7 ounce capacity.

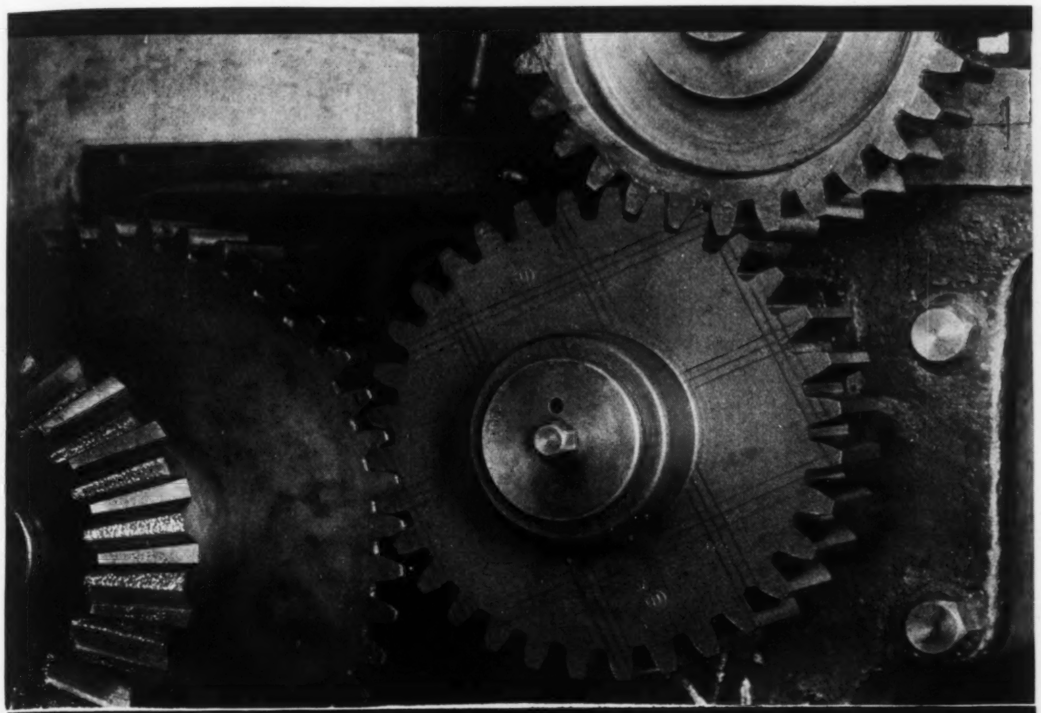
Oiler is made to allow a specified amount of oil to drip continuously on bearing

Wooden Sheaves Have Many Uses

WOODEN sheaves, available with oilless wooden bearings, have been placed on the market by Metzgar Co., Grand Rapids, Mich. The End-Wood sheave presents end-grain, hard maple to the cable or rope turning in it. It is said to be weatherproof and exceptionally quiet running. Where plain bearings are sufficient, the sheave can have oilless wood bear-

Sheaves are available with wooden oilless bearings or ball and roller types

(*Continued on Page* 78)



SILENCE and SERVICE

FORMICA gears, for many years, have proved that they are highly serviceable. When properly cut in the right sizes they usually outwear metal gears. There is no grind and screech, and as they are elastic they take up shocks in the driving train and save the machine—especially if it is subject to spasmodic or reversing action.

That dependability is well known to machinery buyers. And the silent operation Formica gears make possible is a strong selling point. They help to sell the machines.

Formica gears also make life easier for maintenance engineers, who buy replacement gears of Formica from the leading cutters named on this page.

THE FORMICA INSULATION COMPANY
4640 Spring Grove Avenue, Cincinnati, Ohio

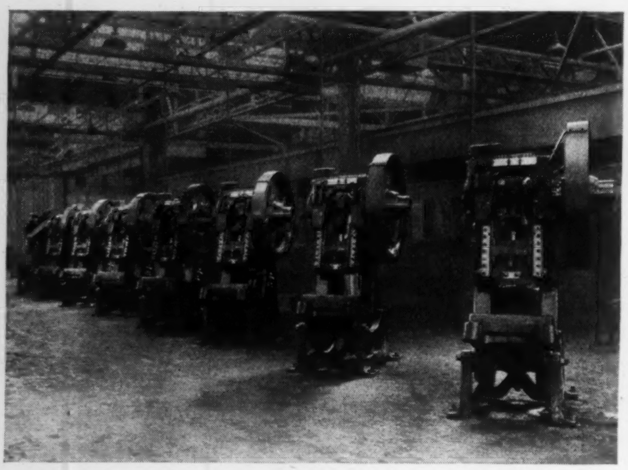
FORMICA

FORMICA
GEAR CUTTERS

●

The Akron Gear & En'g Co.
Akron, Ohio
Farrel-Birmingham Co.
Inc., Buffalo, N. Y.
Slaysman & Company
Baltimore, Md.
Harry A. Moore
Bangor, Me.
The Union Gear & Mch. Co.
Boston, Mass.
Chicago Rawhide Mfg. Co.
Chicago, Ill.
Perfection Gear Company
Chicago, Ill.
Gear Specialties, Inc.
Chicago, Ill.
Merkle-Korff Gear Co.
Chicago, Ill.
Chicago Gear Works
Chicago, Ill.
Foote Gear Works
Cicero, Ill.
The Cincinnati Gear Co.
Cincinnati, O.
Clarksville Foundry &
Machine Co.
Clarksville, Tenn.
The Horsburgh & Scott Co.
Cleveland, O.
The Stahl Gear & Machine Co.
Cleveland, O.
The Master Electric Co.
Dayton, O.
The Adams Company
Dubuque, Ia.
Hartford Special Mchny. Co.
Hartford, Conn.
Beaty Machine Works
Keokuk, Ia.
The Generating Gear Co.
Milwaukee, Wis.
Badger State Gear Co.
Milwaukee, Wis.
Precision Machine Co.
Milwaukee, Wis.
E. A. Pynch Co.
Minneapolis, Minn.
Joaquin Alemany Lopez
Havana, Cuba
New Jersey Gear & Mfg. Co.
Newark, N. J.
Prager, Inc.
New Orleans, La.
J. Morrison Gilmour
151 Lafayette St.,
New York City
Sier-Bath, Inc.
New York City, N. Y.
Mid-State Electrical Engineering Co., Osceola Mills, Pa.
E. M. Smith Machine Co.
Peoria, Ill.
The Eagle Gear & Mch. Co.
Philadelphia, Pa.
Rodney Davis and Sons
Philadelphia, Pa.
The Pittsburgh Machine &
Supply Co., Pittsburgh, Pa.
Perkins Machine & Gear Co.
Springfield, Mass.
Winfield H. Smith, Inc.
Springville, N. Y.
Alling Lander Company
Sodus, N. Y.
Charles E. Crofoot Gear Corp'n,
South Easton, Mass.
Arlington Machine Co.
St. Paul, Minn.
Farwell Mfg. Co.
Toledo, Ohio
Diefendorf Gear Corp.
Syracuse, N. Y.
Worcester Gear Works
Worcester, Mass.
Massachusetts Gear & Tool Co.,
Woburn, Mass.

●



FARVAL GIVES

Exactly Enough

LUBRICANT

NOT TOO MUCH
NOT TOO LITTLE
EXACTLY ENOUGH

• Adequate lubrication is *balanced* lubrication. Regardless of size, type, or number of bearings in the production machines you build, the Farval System will deliver the exact amount of lubricant to each—serving all and missing none, no matter how remote.

The Farval Centralized System of Lubrication protects your customers against repair and replacement, by maintaining an adequate film of lubricant on the bearings at all times. It reduces the labor of oiling, prolongs life of equipment, and insures continuous production.

Design Engineers are invited to write for complete information and technical data. The Farval Corporation, 3265 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

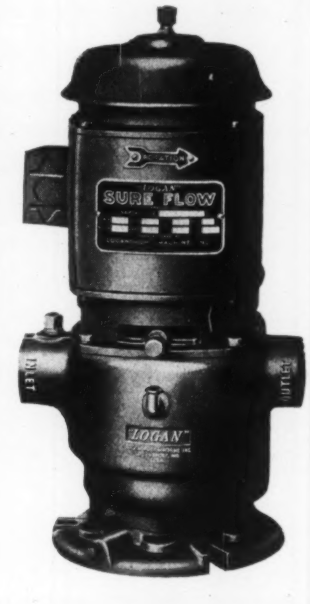
Special Delivery to Every Bearing

(*Continued from Page* 74)

ings; it is also available with ball or roller bearings. The sheaves are suitable for applications where a quiet running, trouble-free unit is desired such as in sewing machines, office equipment, etc.

Pump is Self-Priming

NO ACCESSORIES, such as auxiliary priming reservoir, foot or check valves are needed in the "Sure Flow" inherently self-priming pump, introduced by the Logansport Machine, Inc., Logansport, Ind. Because of its self-priming characteristics this centrifugal pump may be mounted at the point of greatest convenience and piped to the source of supply. Since entrained air or vapor do not interfere with the operation, this pump will handle liquids up to the boiling point. The pump is made in ten sizes, ranging from 4 to 150 gallons per minute and is available with direct motor drive, sub shaft adapted for vertical power take-off and as belt-driven unit.



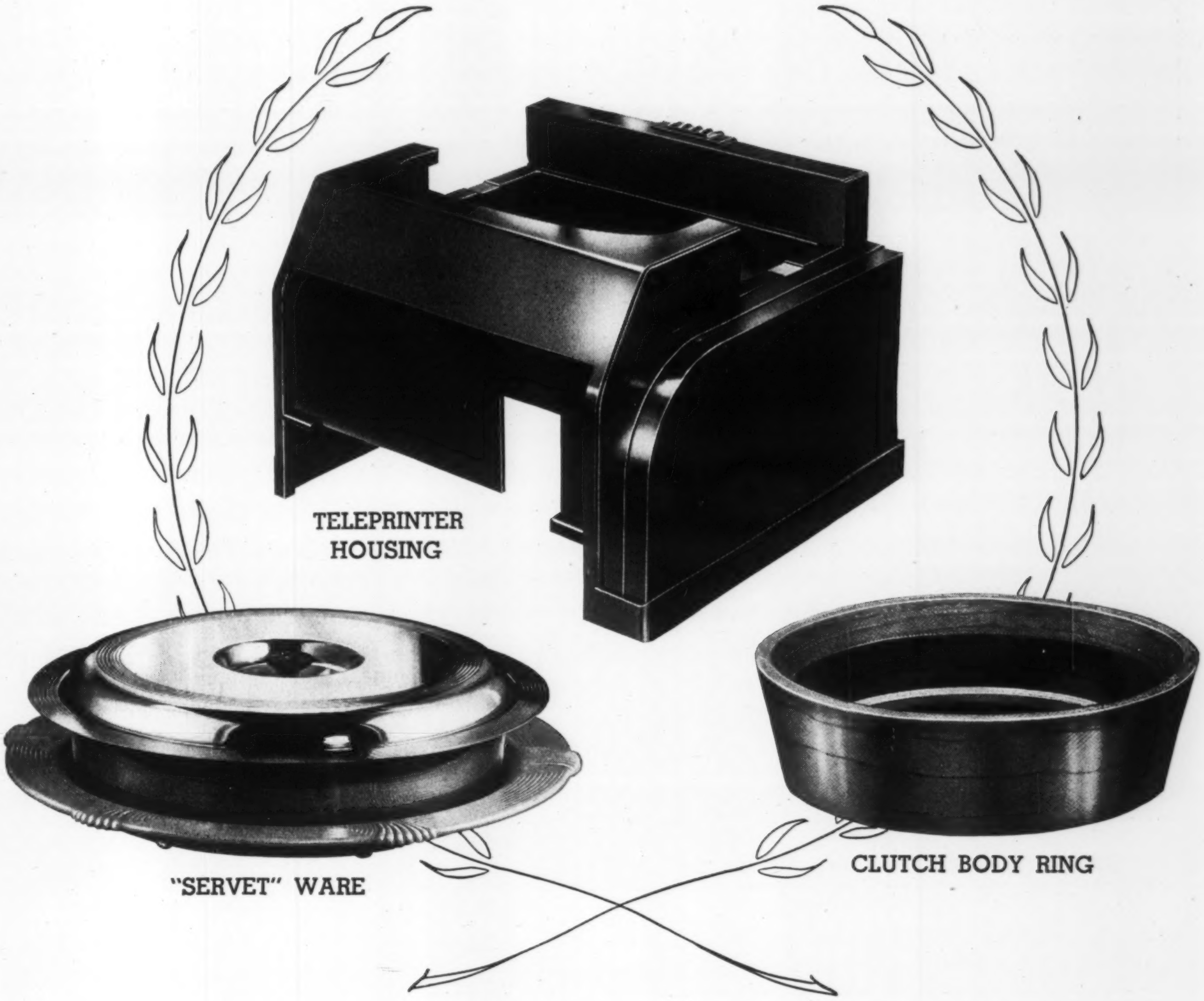
Pump casing is cast integral with motor support, insuring correct alignment of motor and pump

Corrosion Resistant Plastic Developed

SYNTHETIC yarn equipment which must operate in corrosive chemicals, and automobile water pump impellers to resist antifreeze and cleaning solutions are two uses of a Durez molding material, 77SB, developed by General Plastics, Inc., North Tonawanda. N. Y. Unique among plastics for its inertness, 77SB also resists frictional wear and permits machining operations without impairment of its properties.

Double Thickness Flexible Tubing

FLEXIBLE tubing, having the braid imbedded between two corrugated seamless tubes, forming an



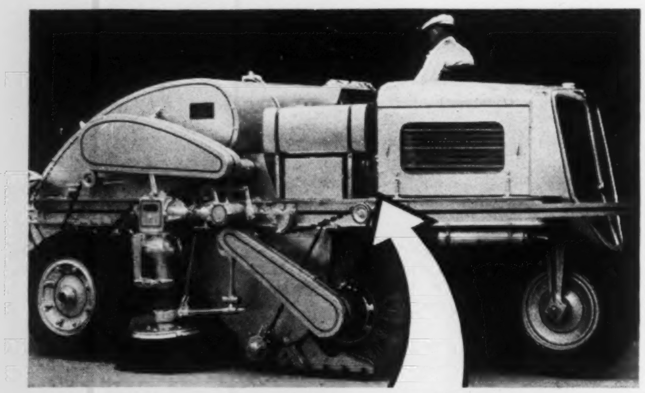
FOR ENGINEERING, ADAPTABILITY,
DESIGN AND ACCURATE MOLDING

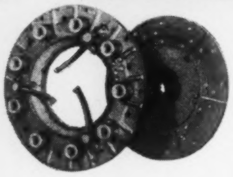
General Electric Textolite Receives Two Prize Awards
and an Honorable Mention
in the Second Annual Modern Plastics Competition

To the Western Union Telegraph Company (Teleprinter Housing), Steelsmiths, Inc. (Servet Ware) and the Brown and Sharpe Mfg. Company (Clutch Body Ring) General Electric extends its congratulations. G. E. is proud to have developed the facilities, the Textolite compounds and the molding technique which have made possible the molding of these three applications.

GENERAL GE ELECTRIC
Plastics

PLASTICS DEPARTMENT, GENERAL ELECTRIC COMPANY, PITTSFIELD, MASS.



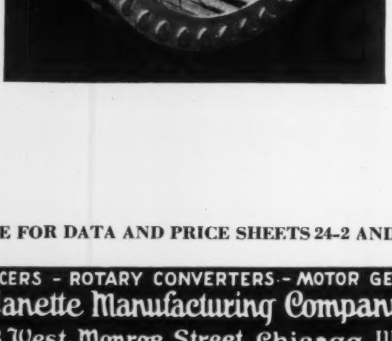


ROCKFORD
Spring-Loaded Clutch
Performs Double Duty

The Rockford Spring-Loaded Clutch in an Elgin Street Sweeper performs the double duty of driving the vehicle and the sweeper mechanism at the same time. Load is especially heavy in starting yet the Rockford Clutch picks it up smoothly, carries it steadily, and releases it quickly when required. Elgin engineers secured this outstanding performance by selecting the right size Rockford Clutch and installing it properly. Rockford Spring-Loaded Clutches operate like an automobile clutch; are made with single or double drive plates; for operation in oil or dry; in sizes from 8" to 20" diameter for transmitting 2 h.p. to 60 h.p. at 100 r.p.m.

New 24-Page Booklet—Contains complete information on sizes, dimensions and capacities of Pullmore Multiple Disc Clutches; has 26 illustrations of typical applications. Write for a copy, today.

ROCKFORD DRILLING MACHINE DIVISION
Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

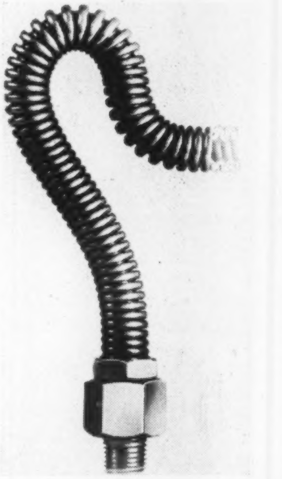


Janette
Blower Wheels

WRITE FOR DATA AND PRICE SHEETS 24-2 AND 24-27

SPEED REDUCERS - ROTARY CONVERTERS - MOTOR GENERATORS
Janette Manufacturing Company
556-558 West Monroe Street Chicago, Ill. U.S.A.
BOSTON - NEW YORK - PHILADELPHIA - CLEVELAND - MILWAUKEE - LOS ANGELES
DETROIT - SEATTLE

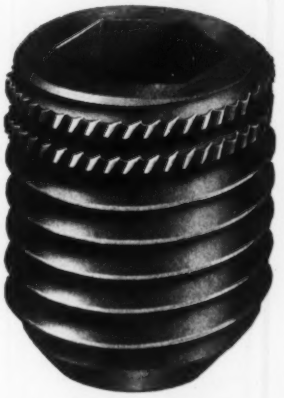
all metal, weldless, jointless and packless metal hose has been brought out by Seamlex Co., 10 48th avenue Long Island City, N. Y. This triple safe tubing, made of a bronze alloy, is noncorrosive and particularly resistant to frequent flexing and severe vibration. Male or female pipe thread fittings consist of only two parts and form a leakproof joint without soldering, brazing or packing. Standard sizes of ¼, 5/16, ⅜ and ½-inch inside diameter are carried in stock.



Thread fittings are easily fastened to tubing to give leakproof joint

Set Screw Is Self-Locking

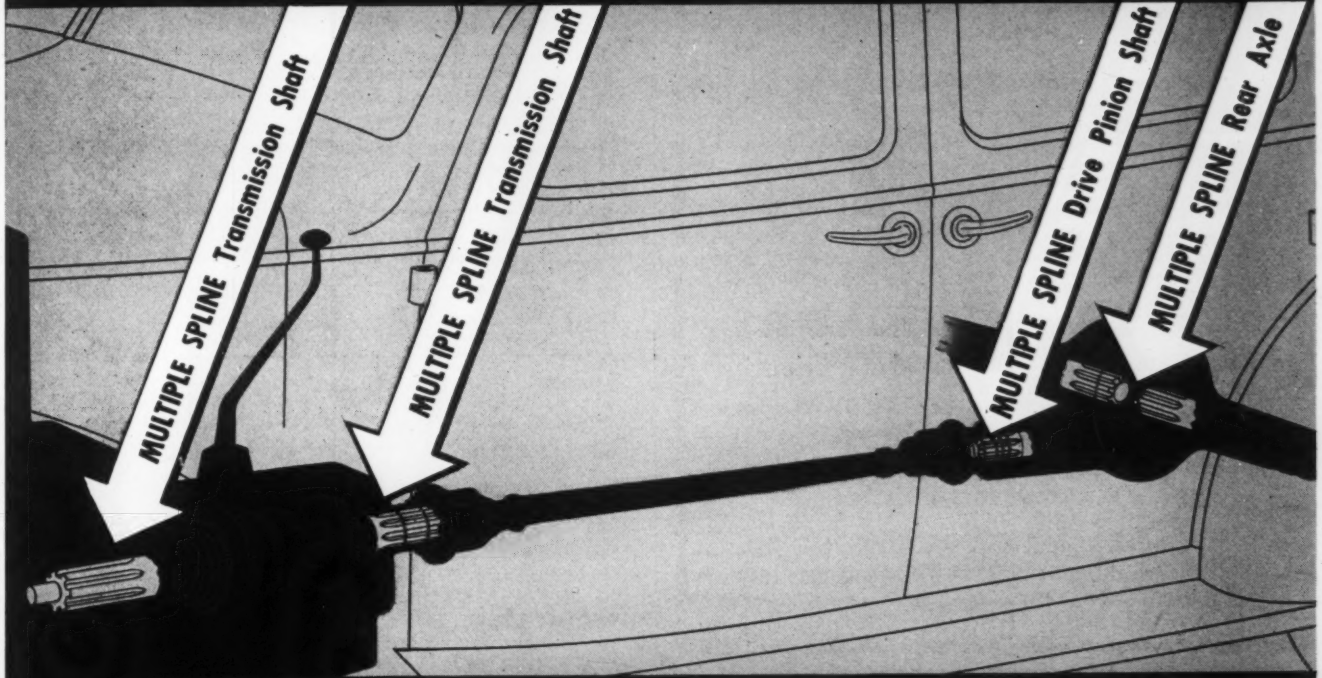
SET screw having self-locking thread has been introduced by Standard Pressed Steel Co., Jenkintown, Pa. By knurling the top of the thread on an angle, the metal is swaged on the upper side making prongs which dig into the collar and lock the screw. There is enough clearance between the threads to allow the screw to be inserted without difficulty, but when the cup point engages the shaft, the threads of the "Unbrako" back up against the sides of the threads of the tapped hole driving the prongs into the collar. This self-locking screw works equally well in steel, cast iron, bronze and brass. The first application is the most efficient, but it is possible



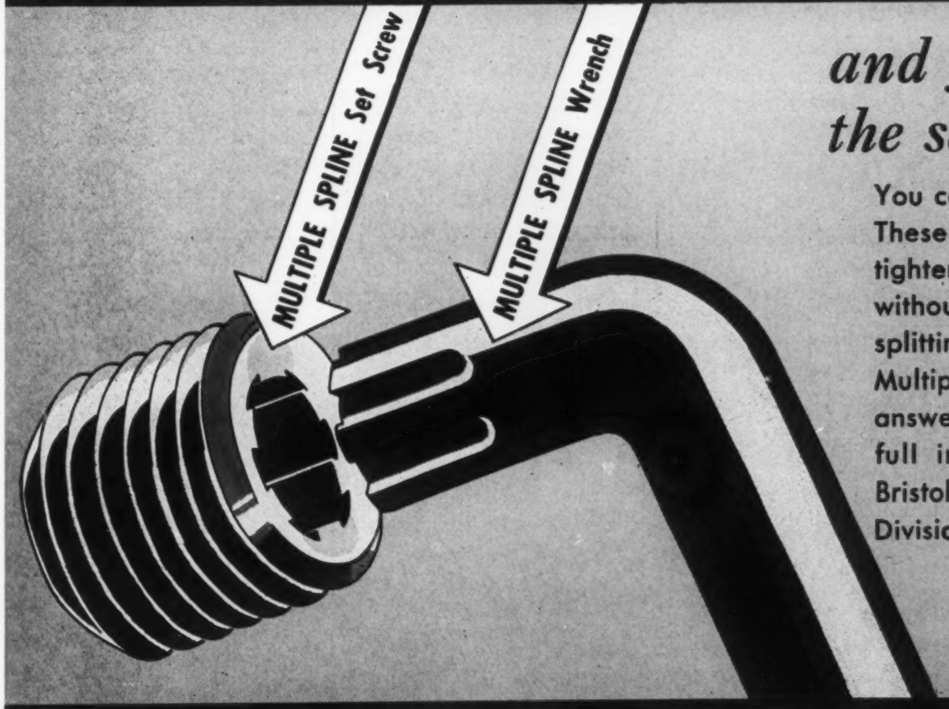
Screw is inserted without difficulty, but does not loosen as knurled threads engage with collar

MULTIPLE SPLINE

Autos use it!


MULTIPLE SPLINE Transmission Shaft
MULTIPLE SPLINE Transmission Shaft
MULTIPLE SPLINE Drive Pinion Shaft
MULTIPLE SPLINE Rear Axle

. . . Bristos use it!


MULTIPLE SPLINE Set Screw
MULTIPLE SPLINE Wrench

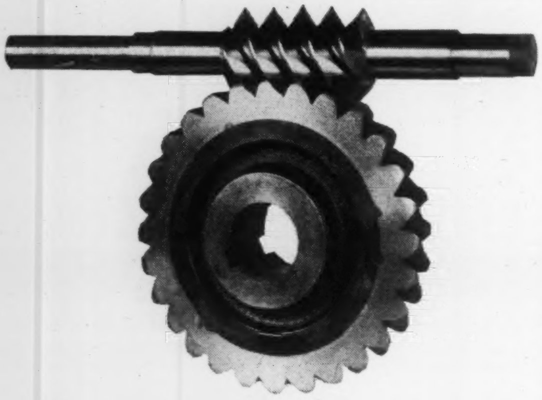
and for the same reasons

You can give it all you've got! These Bristo screws can take a tighter set-up time after time without a chance of shearing, splitting, rounding or stripping. Multiple spline design is the answer! Bulletin 833 contains full information. Write. The Bristol Company, Mill Supplies Division, Waterbury, Conn.

SET SCREWS BRISTO CAP SCREWS

TRADE MARK REG. U.S. PAT. OFF.

D.O. JAMES WORM GEARS AND WORM GEAR REDUCERS



50 YEARS OF GEARS

assures you an accumulated experience that is invaluable in the production of Standardized Worm Gear Reducers.

Send for Catalog No. 140—containing 68 pages of Worm Gear Reducer information.

D. O. JAMES MANUFACTURING CO.
1120 W. MONROE STREET • CHICAGO, ILLINOIS
ESTABLISHED 1888

Fundamentals of

MACHINE DESIGN

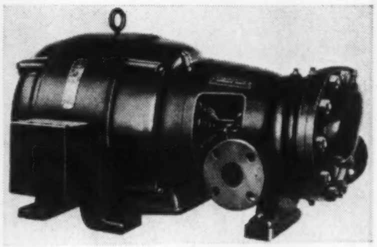
The new text by three outstanding experts—*C. A. Norman*, Professor of Machine Design at Ohio State University, *E. Stanley Ault*, head of Machine Design at Purdue University, and *Ivan F. Zarobsky*, Professor of Mechanical Engineering at the University of Toledo—gives the student of engineering a thoroughly practical, professional knowledge of the design of machine elements and their use in modern machines. Illustrated, 530 pages, $4.25.

MACMILLAN NEW YORK

to back off the screw several times before the locking qualities are lost.

Pump-Motor Unit Developed

BUILT to operate against heads up to 500 feet, a two-stage pump with built-in motor has been placed on the market by Fairbanks, Morse & Co., 900 S. Wabash avenue, Chicago. The unit consists essentially of a two-stage centrifugal pump, with enclosed bronze impellers, mounted directly on the shaft of a splashproof motor. Two rugged ball bearings take all of the radial and unbalanced thrust loads, and impellers for the two stages are placed back to back, compensating thrust.



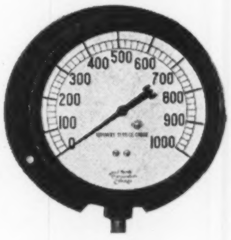
Two-stage pump has impellers placed back to back to compensate thrust

Protection Gained with Lead Pigment

METALLIC lead pigment which, when mixed with suitable vehicles, gives excellent protection to metal and other surfaces against corrosion has been developed by Metalead Products Corp., Balfour Bldg., San Francisco, Cal. Leadleaf metallic paste, when mixed with vehicle, will serve as a priming coat for bare metal and as a sealing coat on concrete or wood. It will not blister or flake under extreme climatic conditions and resists the action of acids and alkalies. The paint may be sprayed, brushed or used in dip tanks provided with agitators. It is resistant to temperatures up to 500 degrees Fahr.

Pressure Gage Is Improved

STAINLESS steel bourdon tube and a new method of zero adjustment feature a pressure gage developed by Jas. P. Marsh Corp., 2073 Southport avenue, Chicago. For pressures below 100 pounds per



Special socket and cone, employing lathe threads, make joint that will withstand high pressures and temperatures

MICRO SWITCH
TYPE Z

LET THE NEW

MICRO SWITCH

Solve Your Out-of-Ordinary Electric Contact Problems—

TYPE Z

A new super-sensitive Micro Switch. Operating pressure, 8½ oz.; release pressure, 6½ oz.; movement differential 0.0003". For thermostat, flame and fan control in *Air Conditioning;* in metal housings for limit stops in *Machine Tools;* for thermostats in *Incubators;* for controls in *Instruments;* for stops in *Business Machines;* and hundreds of other uses.

1—Heater Loads 1200 watts up to 600 volts. Inductive loads, solenoids, relays, etc., A. C.

2—Operates on 0.0002" to 0.0003" movement (Triple zero)—8½ oz. pressure.

3—Can be used in any position—vibration resistant.

4—60 or more snaps per minute—millions of operations.

5—Underwriters' Laboratories listing and Ontario H. E. P. C. approval. Size $1\frac{15}{16}'' \times \frac{27}{32}'' \times \frac{11}{16}''$.

Write for specifications and recommendations covering Z Switch applications.

MICRO SWITCH M·S **CORPORATION**
13 East Spring Street Freeport, Ill., U. S. A.

Offices in New York and Chicago

Have you this catalog of the full line? — —
B·S
Brown & Sharpe Pumps
Geared, Vane and Centrifugal

—It will pay you to keep a copy at hand. Write now—
Brown & Sharpe Mfg. Co.
Providence, R. I.

5-Time Inspection
GIVES DUMORE MOTORS MORE
Power Hours

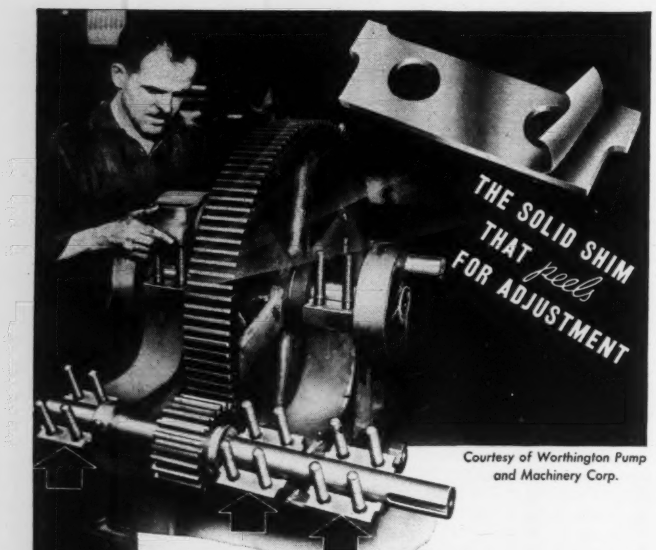
Dumore parts and motors get a 5-time inspection in manufacture — and in addition, an *ENGINEERING* inspection—all assuring the utmost in performance.

- **Armatures are dynamically balanced at high speed and then tested and retested to assure vibrationless running.**
- **Armature windings are expanded at high speed, then sealed, and finally tested to make sure there is no "breathing."**
- **Commutators are ground concentric with the bearings and given running tests to assure maximum brush life.**
- **Armature leads are swaged by special Dumore process and tested for 100% electrical contact.**
- **Assembled motors are "run-in" to seat brushes and are then given final electrical tests and inspection.**

Dumore makes a full line of Universal Motors — 1/600 to 3/4 h.p. — A. C.-D. C. — 0 to 60 cycles — and you can get parts "tailor made" to fit specific products. Let Dumore Engineers help you. Engineering Service Application blank sent with new catalog. Write today.

THE DUMORE COMPANY
Dept. 127-M RACINE, WIS.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS



Courtesy of Worthington Pump and Machinery Corp.

ease in pump assembly

Quick precision adjustment of reciprocating pump bearings and gear shaft, for example . . . By simply peeling the paper-thin laminations from the solid brass Laminum shim. Right at the job . . . in assembly AND service adjustment! No filing, no machining. Write for Laminum sample (.002 or .003 in. laminations).

LAMINATED SHIM CO., INC. 21-26 44th Ave., Long Island City, N. Y.
Cleveland Detroit Milwaukee
933

LAMINUM
Precision adjustment SHIMS

A reproduction of Model AG with clutch and power take-off.
•
9 sizes—1 to 16 H.P.

....NO NEED TO "WET-NURSE" WISCONSIN AIR-COOLED ENGINES

No water to give trouble in freezing or boiling temperatures. No grease cups or oil fittings which are always neglected. Wisconsin air-cooled engines take care of themselves.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

square inch a drawn steel bourdon tube is used, but for pressures over 100 pounds per square inch the gage incorporates a lathe-turned tube. By employing lathe threads and a special socket and cone, a joint has been developed that will hold tight up to the melting point of steel and withstand pressures far beyond those of any given gage. The instruments are moisture, vapor and dustproof throughout and have corrosion resistant cases.

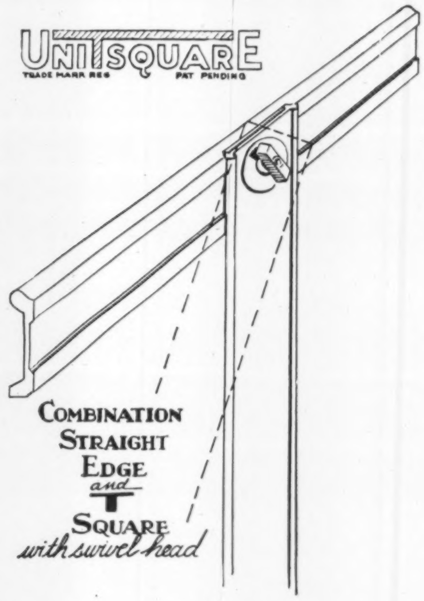
Primer Is Quick Drying

SYNTHETIC primer for use on metal products that air dries in five minutes has been developed by Maas and Waldstein Co., Graybar Bldg., New York. This new "speed" primer is suitable for use under air-drying lacquer enamels or baking synthetic enamels, or as a shop coat. The primer has good adhesion, excellent building and holding properties and is easily sanded. It is supplied in many colors for either dipping or spraying.

Engineering Department Equipment

Metal T-Square Offered

CHANNELED blade of the Unitsquare, all-metal T-square brought out by Cardinell Corp., Montclair, N. J., eliminates to a great extent smudging caused by constant rubbing over pencil lines. Being made of metal the T-square will never warp nor be affected by climatic conditions. Head swivels to a position parallel with the blade for easy handling and may be entirely removed allowing blade to be used as a straight edge. Slightly rounded edges of the blade keep ink from crawling under blade and smudging. Blades are available in lengths from 18 to 72 inches.



Movable head on metal T-square allows for various angles. Head may also be removed and blade used simply as straight edge

MEETINGS *and* EXPOSITIONS

Dec. 6-10—

American Society of Mechanical Engineers. Annual meeting and technical sessions to be held in New York. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Dec. 6-11—

Exposition of Chemical Industries. Sixteenth exposition to be held at Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York, is in charge.

Jan. 5—

Motorcycle and Allied Trades association. Annual meeting to be held in Hotel Lexington, New York. E. C. Smith, 8 East Long street, Columbus, O., is secretary.

Jan. 13-15—

American Engineering Council. Annual meeting to be held at Mayflower hotel, Washington. Frederick M. Feiker, 744 Jackson Place, Northwest, Washington, is executive secretary.

Jan. 17-20—

National Association of Coin-Operated Machine Manufacturers. Annual meeting and exhibit to be held at the Sherman hotel, Chicago. Clinton S. Darling, 120 South LaSalle street, Chicago, is secretary.

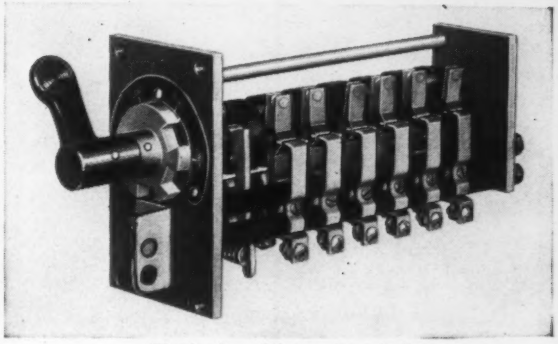
Jan. 24-26—

National Warm Air Heating and Air Conditioning association. Semiannual meeting to be held at Roosevelt hotel, New York. Allen W. Williams, 50 West Broad street, Columbus, O., is secretary.

Jan. 26—

American Society of Refrigerating Engineers. Annual meeting to be held at Roosevelt hotel, New York. David L. Fiske, 37 West Thirty-ninth street, New York, is secretary.

CONTROL 10 CIRCUITS
By a Flip of the Handle



Typical multicircuit switch

A NEW FINGERTIP CONTROL
THAT'S ASSEMBLED TO MEET
THE DESIGNER'S NEEDS

HERE'S a versatile new cam switch that can serve a host of purposes in your latest machine tools.

By its use, you can operate any number of control circuits in sequence. In many cases, it will eliminate the necessity of complicated relaying connections.

New Roller-cam Construction

The use of twelve interchangeable rollers for the cam makes it possible to assemble the switch with any desired sequence of contact closing for the twelve points—either at the factory or in the field. Thus the utmost flexibility is provided.

The next time you need a multicircuit switch, give this G-E cam switch a trial. We shall be glad to show you one of them and explain in detail its unique construction. General Electric, Schenectady, N. Y.

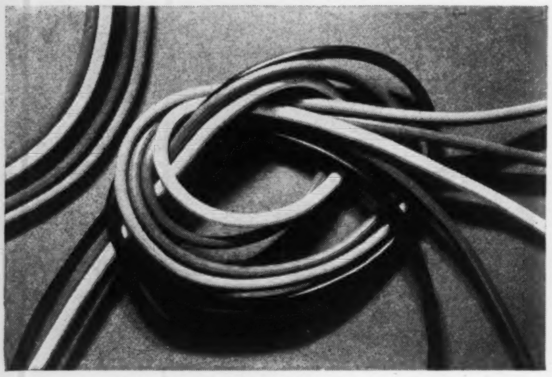
GENERAL ELECTRIC
080-135

FLAMENOL

REG. U. S. PATENT OFFICE

WIRE FOR YOUR MACHINES

Adds New Talking Points



WHEN you can say that your product is wired with Flamenol, you give prospects some refreshing news.

Flamenol—the G-E synthetic rubber-like compound that covers this wire—is a natural for sales talks. It combines the properties of an insulation and finish, and seldom needs any protective covering. It is flame-, moisture-, and oil-resisting, superaging, and good-looking. It comes in many bright colors, making easy the identification of circuits.

Look into Flamenol wire for low-voltage circuits on high-grade equipment—such as machine tools; for battery, coil, and motor leads and for any use where its properties are the only ones that fully meet conditions. More information will gladly be given; address the nearest G-E sales office or General Electric, Dept. 6A-201, Schenectady, N. Y.

520-124

GENERAL ELECTRIC

Textile Machine Design

(*Continued from Page* 32)

volume in no one size justified the die cost. Accordly experiments were made in the foundry with chills, dry sand cores, and faced green sand molds. Because of the shape of the casting, the last named method of manufacture proved to be the best and was adopted.

The mechanism of the looms through which the shuttle derives its motion is one that presents many interesting problems. This piece of machinery, known to the trade as the "picking motion," is shown in the schematic view, *Fig.* 8. Frequently criticized by engineers from other industries, it is in its present form a vast improvement over the mechanism that was used in the past. So satisfactory is it to the mills that attempts to propel the shuttle with compressed air, electricity, or other mechanical means, have failed to supplant it.

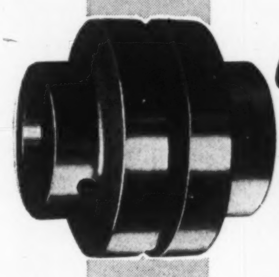
Referring to *Fig.* 8, the picking motion has an arm fastened to the main or bottom shaft of the loom. The free end of the arm carries a stud or bushing upon which there is a cam roll. This roll wipes a cam fastened to a square shaft which in turn carries an arm, connected to a stick. The upper end of the stick is provided with a rawhide "picker," not shown, which is in contact with the point of the shuttle.

From Rest to High Velocity

The function of these parts is to bring the shuttle from rest up to a velocity of approximately 40 feet per second in a distance of 9½ inches. In doing so, the roll arm can turn only through an angle of approximately 30 degrees because of the slow speed of the shaft. The slope of the cam then is not over 4 inches in length and is very abrupt despite the fact that it is designed for a condition of uniform acceleration. That acceleration is in the neighborhood of 500 feet per second per second and cannot be less because of time limitations in the cycle of operation of the machine.

These conditions impose what amounts to an impact load on the parts of the picking mechanism, especially when consideration is given to the sudden application of power which is present with any looseness in the connecting parts. Thus the roll, its supporting member, and the cam are subject to the wear of rotation, rolling and impact. The roll for years has been made of gray cast iron, chilled on the outside and soft in its bore. The outside generally has withstood wear in a satisfactory manner except for a certain amount of chipping. The bore, however, has worn badly because of faulty lu-

CONGRESS *Flexible* MOTOR COUPLINGS



A FLEXIBLE coupling that offers machine designers a solution to obstinate coupling problems.

Couplings can be supplied with oil and water resisting inserts when required.

Congress Flexible Couplings are obtainable in six sizes for use with fractional horsepower motors or motors up to 25 horsepower and are guaranteed to be efficient, silent and low in cost.

Our engineering department will be glad to furnish complete engineering data on request.

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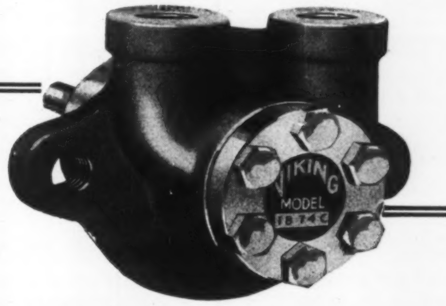

Your Rotary PUMPING PROBLEM *Must Have The* RIGHT ANSWER!

For the immediate solution to any of your difficult rotary pumping problems, install Viking. Positive action, high efficiency and low first cost adds up to the perfect answer. Write today for complete, illustrated bulletins.

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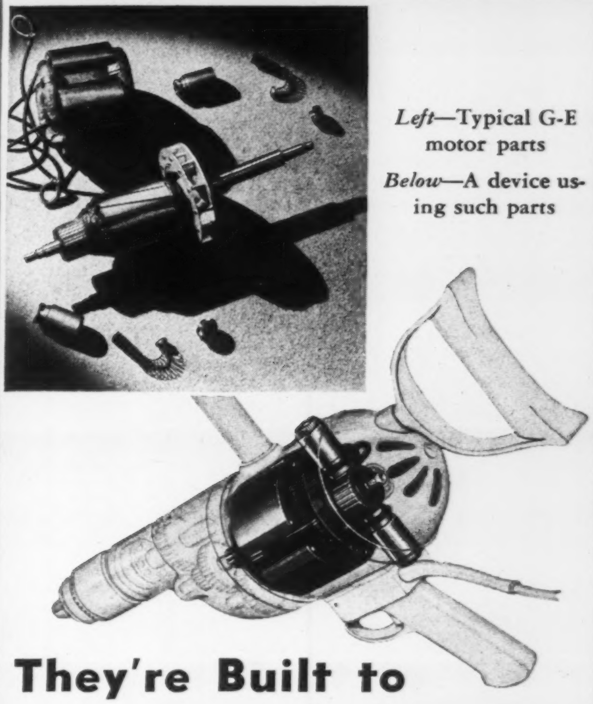
CEDAR FALLS, IOWA

MORE THAN JUST MOTOR PARTS



Left—Typical G-E motor parts

Below—A device using such parts

They're Built to Match Your Devices

When you buy G-E motor parts, you get, in addition to the parts, engineering service that means longer-lived devices and satisfied users. G-E engineers have successfully applied high-speed motor parts to such devices as drills, sanders, routers, shapers, reamers, mixers, hammers, saws, and valve seaters. These specialists will be glad to work with you and give you the benefit of their many years of experience in selecting torques, speeds, gear trains, mounting arrangements, and ventilating systems. They may also be able to show you how to save on materials, machining, and assembling.

General Electric offers a complete line of universal series-motor parts in ratings from 1/100 to 1 1/3 hp at speeds from 5,000 to 10,000 rpm, for operation on either alternating or direct current up to 250 volts. For additional information, ask the nearest G-E sales office for GEA-1942, or write General Electric, Schenectady, New York.

070-194

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ATTRACTIVE FACES
for Your Equipment

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D-C MILLIAMPERES
GENERAL ELECTRIC
DC VOLTS
30
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90
120
150
RESISTOR INTERNAL
GENERAL ELECTRIC
TYPE DO-41

BUYERS' eyes always focus on the face of your equipment—the instruments. That is why it will pay you to make certain that they are attractive G-E instruments; that they have the G-E accuracy, sturdiness, and sound design. The G-E monogram will tell the buyer that you build with the best in electric equipment. It will mean quicker, easier sales.

For an instrument to fit your equipment, come to
Headquarters for Electrical Measurement

430-97
GENERAL ELECTRIC

brication. This difficulty has been overcome by an improved stud. This is made of heat-treated S.A.E. No. 3135 steel. In its end it has a grease fitting which, through internal passages, supplies the lubricant to the wearing surface.

Th cam surface struck by the roll is chilled to a depth of approximately 3/16-inch. Some wear takes place on the point of the cam, but in the latest designs that does not affect the velocity of the shuttle. The cam is designed so that the end of the acceleration period is passed before the point of the cam is reached.

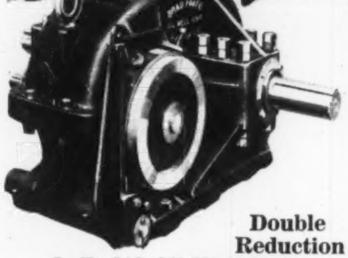
The curved arm formerly was a constant source of trouble. It was made of a drop forging in which a square hole was broached to fit the shaft. The arm was driven on the shaft and was held by two set screws. This arm became loose on the shaft to the detriment of the shuttle velocity. The obvious course of action was to lengthen the hub. This solution, however, introduced machining troubles. Accordingly malleable iron was used with mediocre success. The hub was lengthened, the machining was eased by the use of a chambered core in its interior, and the two set screws were replaced by a clamping arrangement. But the result was as bad as before. Finally a new drop forging was made and was welded to the shaft. It solved the problem.

Lubricants Are Specified

Textile machinery manufacturers have approached their problems of wear elimination as indicated by the foregoing examples. More recently concentrated attention has been given to the matter of lubrication because many mills needed assistance in buying their lubricants and in establishing some regular routine for oiling and greasing the different bearings of their machinery. A laboratory study has been made to the end of establishing specifications for the various lubricants that are required for looms. These specifications, together with the trade names of the products of a large number of lubricant manufacturers, are supplied to the mills. In addition, a chart is sent with all new machinery showing the frequency with which the main bearings should be lubricated.

Another recent development is in the direction of providing alloy cast irons, including such elements as chromium, nickel and molybdenum. Materials of various characteristics are obtainable. Some are used because they are denser and stronger than regular gray cast iron, some because they are tougher and more resistant to impact, and some because through heat treatment they can be made highly resistant to abrasion.

Brad Foote
OIL WELL UNIT
PUMPING REDUCERS



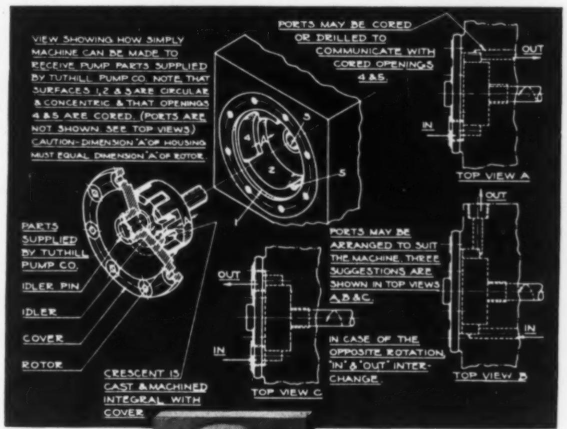
Double Reduction
O. P. 612 Oil Well Unit

The long experience of the Brad Foote organization—in designing and manufacturing speed reducers to give the exact maximum in continuous and dependable service—is proving itself daily in plants generally throughout the country.

The rigorous specialized conditions in the oil fields—the manner in which they are met with the various types of Brad Foote reducers is added proof of this ability.

FOOTE GEAR WORKS INC.
1301 S. CICERO AVE., CICERO, ILL.

BUILD THE PUMP *Into* YOUR MACHINE

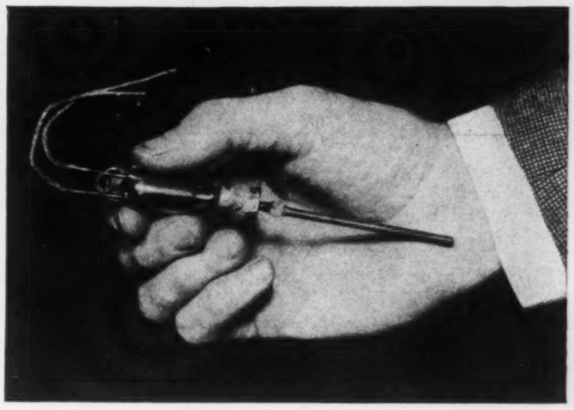

VIEW SHOWING HOW SIMPLY MACHINE CAN BE MADE TO RECEIVE PUMP PARTS SUPPLIED BY TUTHILL PUMP CO. NOTE THAT SURFACES 1,2 & 3 ARE CIRCULAR & CONCENTRIC & THAT OPENINGS 4 & 5 ARE CORED. (PORTS ARE NOT SHOWN. SEE TOP VIEWS.) CAUTION-DIMENSION 'A' OF HOUSING MUST EQUAL DIMENSION 'A' OF ROTOR.
PORTS MAY BE CORED OR DRILLED TO COMMUNICATE WITH CORED OPENINGS 4 & 5.
OUT
IN
TOP VIEW A
1
2
3
4
5
PARTS SUPPLIED BY TUTHILL PUMP CO.
IDLER PIN
IDLER
COVER
ROTOR
CRESCENT IS CAST & MACHINED INTEGRAL WITH COVER
PORTS MAY BE ARRANGED TO SUIT THE MACHINE. THREE SUGGESTIONS ARE SHOWN IN TOP VIEWS A,B & C.
IN CASE OF THE OPPOSITE ROTATION, 'IN' & 'OUT' INTERCHANGE.
OUT
IN
TOP VIEW C
OUT
IN
TOP VIEW B

Tuthill "Stripped" Pumps enable you to incorporate the pumping elements directly into the design of your machine. They save space, reduce cost and improve appearance. Models available for coolant, lubricating, transfer and hydraulic service. Capacities up to 50 g. p. m.

TUTHILL PUMP COMPANY
941 EAST NINETY-FIFTH ST., CHICAGO, ILLINOIS

Write for Tuthill "Stripped" Pump Bulletin or address your inquiries to Tuthill engineering department.

HAVE YOU SEEN THE NEW G-E VACUUM SWITCH?



Its contacts are sealed against dirt, dust, moisture, and other atmospheric conditions, thereby preventing contact trouble. Moreover, as the contacts move in a vacuum, practically no arcing occurs—which results in long life, measurable in millions of operations.

Where They Can Be Used

They can be used with any mechanism that uses mechanical movement to make, break, or transfer an electric circuit. They are particularly applicable to relays, other control devices, all types of machines, thermostats, limit switches, and the like.

Operation

With its contacts moving in a vacuum, an operating arm welded to a flexible diaphragm provides the motion to make, break, or transfer an electric circuit by an unusually small mechanical motion.

G-E application engineers will be glad to help you apply these switches.

General Electric, Dept. 6B-201, Schenectady, N. Y.

Please send me a copy of GEA-2657A, a descriptive sheet on the new vacuum switch.

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180-9

GENERAL ELECTRIC

ROTARY PUMPS

For
HYDRAULIC POWER
APPLICATIONS

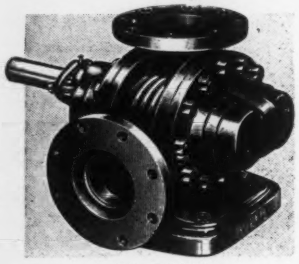

Fig. 999

Roper Rotary Pumps are engineered to embody all of the necessary characteristics of high efficiency pumps . . . simple and compact . . . correct hydraulic principles . . . rugged construction . . . high grade materials and workmanship. They are easy to install and easy to service, cutting labor costs to a minimum. As for operation, their record through the years has proved low upkeep cost, long life and quiet operation.

Write for Bulletin R5MD.

ROPER
PUMPS

GEO. D. ROPER CORP., ROCKFORD, ILL.

PERFECT INSULATION

against Heat like this dramatically displays the ability of WILMINGTON VULCANIZED FIBRE to insulate against even the highest temperatures . . . illustrates the property of heat insulation that, together with its properties of insulation against current, shock, noise and vibration, makes it the ideal material for thousands of uses in all industry. Parts made from WILMINGTON FIBRE possess *all* these advantages, are enduring, attractive—*and usually cheaper to fabricate.* Write for Catalog.

WILMINGTON FIBRE SPECIALTY COMPANY
Wilmington, Delaware

MANUFACTURERS' PUBLICATIONS

ALLOYS—Bulletin No. 135 issued by Shenango-Penn Mold Co., Dover, O., announces results of several years development in producing superior centrifugally cast gray or alloy iron castings. Illustrations are shown of various parts cast by this method.

ALLOYS (NICKEL)—Design and construction of heavy equipment with nickel alloys and the use of nickel-base alloys in production of corrosion resistant machine parts are subjects covered in bulletins T-14 and T-13, respectively, issued by The International Nickel Co., Inc., 67 Wall street, New York.

ALUMINUM—Data on the correct machining of aluminum parts is contained in an attractive, well illustrated booklet prepared by Aluminum Company of America, Pittsburgh.

ASBESTOS—Sheet, block and pipe insulation as well as JM-20 insulating brick for insulating industrial equipment are described in a catalog just released by Johns-Manville, 22 East 40th street, New York.

BEARINGS—The fifth edition of the Timken Engineering Journal has been completed by the Timken Roller Bearing Co., Canton, O. Accurate full and half-size detail bearing drawings are included in the 294 page loose-leaf volume which also incorporates a general discussion of the design and types of Timken bearings now available.

BEARINGS—Principles involved in the sealed ball bearing are given and illustrations of applications are included in booklet D, released by New Departure, Division General Motors Corp., Bristol, Conn.

BELTS—The Manhattan Rubber Mfg., Division of Raybestos-Manhattan, Inc., Passaic, N. J., has just issued an illustrated four-page bulletin on their Condor compensated belts. Engineering data for proper belt selection is included.

CHAINS—Folder No. 1651, published by Link-Belt Co., 307 N. Michigan avenue, Chicago, on No. 4250 swivel chain gives construction details and applications of the chain to conveyor machinery.

CONTROLS (ELECTRICAL)—All types of automatic timing mechanisms for industrial as well as domestic use are described in a folder of Walser Automatic Timer Co., Graybar Bldg., New York.

CONTROLS (ELECTRICAL)—Safety switches, fuses and fuse boxes, industrial control devices and meters are among the subjects covered in a revised catalog

Choose your springmaker wisely

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DIVISION OF ASSOCIATED SPRING CORPORATION

280 SO. CENTER ST., CORRY, PA.

THE MACHINE DESIGNERS' FAVORITE AIR PUMP

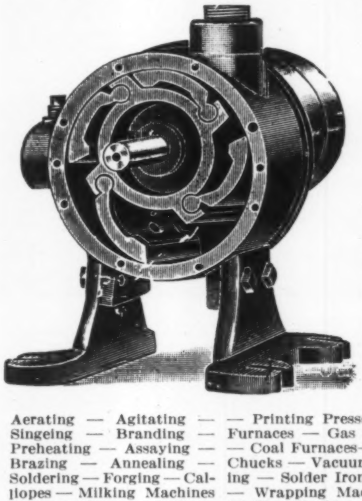
Favorite because of its numerous sizes, its simple lines of construction, but above all because of its reliability —its positive performance which—just because it is so simple in design—can never fail to give its best.

LEIMAN BROS.
Patented Rotary Positive

AIR PUMPS

for pressure, vacuum and gas pumping

They Take Up Their Own Wear



Used on all worth-while automatic machines, paper feeders, bottle fillers, oil burners, and gas appliances.

Aerating — Agitating — Singeing — Branding — Preheating — Assaying — Brazing — Annealing — Soldering — Forging — Calliopes — Milking Machines — Steam Heating Systems — Paper Feeding Devices — Printing Presses — Oil Furnaces — Gas Furnaces — Coal Furnaces—Suction Chucks — Vacuum Cleaning — Solder Iron Heaters — Wrapping Machines — Mailing Machines — Testing Gas Fittings — Removing Foul Air — Supplying Fresh Air — Melting — Hardening — Massaging Machines — Laboratory Work — Blow Lamps — Blow Pipes — Glass Blowing — Gas Pumping — Testing Meters — Pressing Irons — Vacuum Frames

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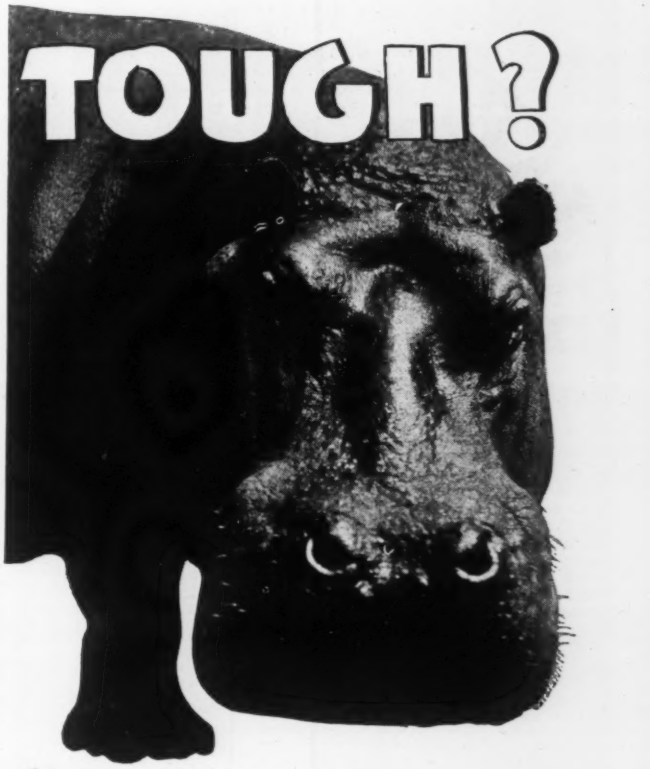
177 Christie St., Newark, N. J.
LEIMAN BROS., N. Y. CO., 23 P Walker St., New York, N. Y.
Makers of Good Machinery For 50 Years



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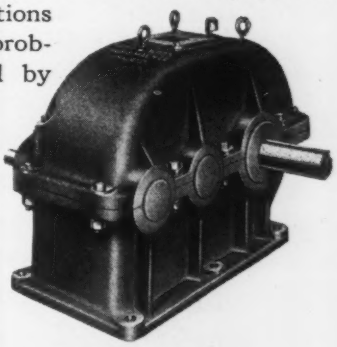
IXL
The Mark of Quality

Toughness, in some things, is of vital importance. A hippopotamus couldn't survive without it; and neither can the gearing in the equipment you design. Equipment gearing needs the ruggedness, strength and dependability of IXL products—products that will stand up under terrific punishment; where maximum power has to be delivered—continuously and smoothly—day after day!

IXL reduction units and gears were designed for tough jobs—and built for tough jobs—by an organization with 77 years' experience as gear specialists. That's why IXL products are standard equipment in thousands of applications and why your gearing problems can best be solved by IXL.



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Send for the valuable IXL handbook "Gear Problems." Free to executives and engineers.

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There is a complete IXL Line, of speed reducers, powered gears, special drives and gears of all kinds, to fit your requirements.

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GEAR & MACHINE CORPORATION
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SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

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Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

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Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

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Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

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Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

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Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

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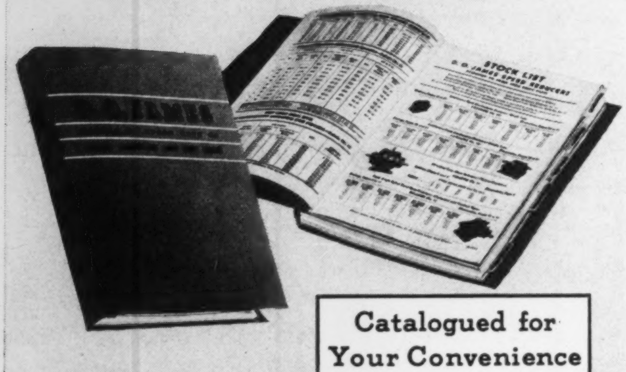
Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY
NEWARK, N. J. — EXPORT DIV., 15 E. 26 St., N. Y. C.

Every Type of
SPEED REDUCER AND CUT GEAR



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450 Pages of Engineering Data, Ratings, Dimensions, Sizes, Weights, Prices and Discounts, of Every Type of Speed Reducer and Cut Gear. We Have Your Copy Ready For You. D. O. James Manufacturing Co., 1120 W. Monroe Street, Chicago, Illinois.

D. O. JAMES

of Colt's Patent Fire Arms Manufacturing Co., Electrical division, Hartford, Conn.

COUNTERS—Illustrations and short descriptions of fifty styles of counters are given in a bulletin just issued by Durant Manufacturing Co., 1926 N. Buffum street, Milwaukee.

COUPLINGS (PIPE)—Description, illustrations and general specifications of a packless pipe coupling made by Packless Metal Products Corp., Long Island City, N. Y., are included in a bulletin recently issued by the company.

FASTENINGS—Washers, small stampings and other diversified products are described in a bulletin "Over 20,000 Varieties" published by Wrought Washer Mfg. Co., Milwaukee, Wis.

FINISHES—Bulletin 800, put out by Metalspray Co., Inc., 113 Llewellyn street, Los Angeles, Cal., describes some of the new applications of metal spraying for preventing wear and corrosion of new parts or for building up worn parts.

GEARS—All types of gears and engineering data concerning them are covered in catalog No. 144-A, issued by D. O. James Manufacturing Co., 1114 W. Monroe street, Chicago.

HYDRAULIC EQUIPMENT—Circular giving details of the new Barnes piston feed pump, including construction and operation of the unit has been issued by W. F. and John Barnes Co., Rockford, Ill.

LIGHTING—Handbook ML6 on localized lighting, issued by The Fostoria Pressed Steel Corp., Fostoria, O., gives specifications and descriptions of the many different lighting fixtures available for building into or on machines.

MOTORS—Bulletin 122 issued by Reliance Electric & Engineering Co., Ivanhoe road, Cleveland, gives data on the splashproof, alternating current, type AA motors made by the company. Details of construction of the explosion-proof alternating current motors is described in bulletin 124.

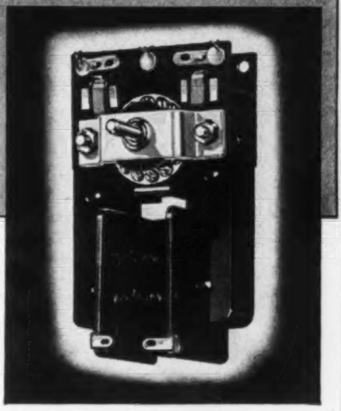
PUMPS—Motor-pump unit for a variety of applications is described in a bulletin issued recently by Fairbanks-Morse & Co., Chicago, Ill.

STEEL—Advantages of arc-welded rolled steel construction are described and illustrated in a booklet prepared by Whitehead & Kales, Detroit.

TUBING—Pocket handbook prepared by The Timken Roller Bearing Co., Canton, O., lists standard tolerances, properties, weight per linear foot and other data on seamless mechanical tubing made by The Timken Steel and Tube Division.

VARIABLE SPEED DRIVE—Reeves Pulley Co., Columbus, Ind., has issued a folder describing their combined transmission and variable speed motor drive, known as the Reeves Vari-Speed Motodrive.

A MINIATURE REVERSIBLE *Powerplant*



for Every Purpose

Just as Alliance engineers developed the tiny motor illustrated above for "Push-button" radio tuning, they can design a motor for other specific requirements.

Alliance miniature motors are available in both reversible and unidirectional models, with or without integral gear reduction assemblies, and can be mounted in any position. Exclusive safety and dependability features make Alliance motors the most rugged and efficient of their kind. Available for all commercial voltages and frequencies. Reversible motors are available for all types of switching and control circuits. Each application receives the individual attention of our engineering department to insure you the most economical and dependable unit for your job.

For additional information wire or write

THE ALLIANCE MANUFACTURING CO.
Alliance, Ohio

RACINE

Variable Volume Hydraulic Pump

A thoroughly proven, efficient pump for power transmission.

Capacities—
0 to 2000
0 to 4000
0 to 6000
cu. in. per min.

The variable volume feature eliminates by-passing of surplus oil, decreases heating and reduces horse-power requirements. Rated for pressures up to 1000 pounds per square inch.

Successfully applied and proven highly satisfactory on such applications as:

- Presses
- Die Casting Machines
- Welding Machines
- Chucking Operations
- Machine Tools
- Table Movements
- Stokers
- Conveyors
- Broaching Machines
- Bending and Rolling Equipment, etc.

A variety of valves and controls are available for standard operations

RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.

The MATCHED QUALITY of DODGE "D-V" DRIVES

GUARDS YOUR GOOD NAME

Dodge "D-V" Drives have that perfectly matched quality which insures efficient power transmission. Both sheave and belt function in perfect harmony—transmitting full power continuously and insuring against costly power loss between source and driven machine whether individually or group driven. There's a Dodge "D-V" Drive for every service. Specify Dodge "D-V" Drives on the machinery which you design.

DODGE
POWER TRANSMISSION EQUIPMENT

NEW!
The third edition of Catalogue D-30 Jr., describing Dodge Power Transmitting Equipment is now available. Copy will be sent on request.

THE *Right* DRIVE FOR EVERY JOB

DODGE MANUFACTURING CORPORATION
MISHAWAKA, INDIANA, U. S. A.

DODGE
MISHAWAKA
THERE IS ADDED VALUE IN THE NAME DODGE

Business and Sales Briefs . . . .

AN ADDITION has been made to the plant of the Dumore Co., Racine, Wis., manufacturer of electric motors, tools, and appliances, comprising two sections for the spraying and baking of paint finishes.

* * *

To provide additional office and laboratory facilities for the Parker Rust-Proof Co., Detroit, a new building is being constructed.

* * *

Graham Transmissions, Milwaukee, manufacturers of variable speed transmissions, has appointed the following representatives: R. L. Johnstone, 1407 North Hanley road, St. Louis; Chas C. Grant, 436 Second National building, Akron, O., and George P. Coulter, 322 Curtis building, Detroit.

* * *

For the past two and one-half years in charge of the sales and marketing of Colmonoy products, Miles C. Smith has resigned to direct the sales promotion and sales of Amercoat, a sprayable plastic made by American Concrete & Steel Pipe Co., Los Angeles.

* * *

According to a recent announcement by Charles H. Cuno, president of the Cuno Engineering Corp., Meriden, Conn., producers of filters of various kinds, contracts have recently been let for an addition to the present factory site, and work is now under way.

* * *

Morse Chain Co. has increased production facilities at its plant at Ithaca, N. Y., and Detroit, by the installation of considerable new equipment.

* * *

W. S. Carson, who has been in charge of the Cleveland office of Detroit Seamless Steel Tubes Co., Detroit, recently was appointed vice president in charge of sales.

* * *

Recent changes in the personnel of Link-Belt Co., Chicago, are as follows: Harold L. Hoefman has been appointed manager of the Link-Belt plant, warehouse and sales office at Atlanta, Ga., to succeed I. H. Barbee, deceased; George A. Paige has been named manager in Detroit; Laurance O. Millard, who joined the company's Chicago plant engineering department in 1913, has been appointed district sales manager at Pittsburgh; and Paul V. Wheeler, connected with the company since 1907, has been made district sales manager at Cleveland.

* * *

Janette Mfg. Co., 556 West Monroe street, Chicago, has appointed Stanley J. Rogers as district representative for the sale of the company's line of products, including motorized speed reducers, electric motors, and motor generators. Mr. Rogers, who has been connected with the company for the past eleven years, will be located at Room 505, 89 Broad street, Boston.

they call 'em the Broncho Busters of Industry

UNSHAKO

The Nut that can't shake loose

Turn the "Unshako" in place and all the vibration or jarring possible will not work it off. Yet it backs off easily when an ordinary wrench is applied. As it is entirely self-contained you'll appreciate that no pins, washers or other gadgets must be fussed with. Write for details.

Fig. 1513

Pat'd. and Pat's. Pending

By turning the knurled "Unbrako" Set Screw in place you lock it there for keeps. The tiny sharp prongs raised by knurling the two top threads dig right into the threads of the tapped hole and prevent even the slightest working loose. More than 2,000,000 have been sold to satisfied users.

Write for literature.

UNBRAKO

SELF-LOCKING HOLLOW SET SCREW

FIG. 1564
PAT. APPLIED FOR

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

BOX 102

BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

BRANCHES
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SAN FRANCISCO

NOW READY

1937 Index

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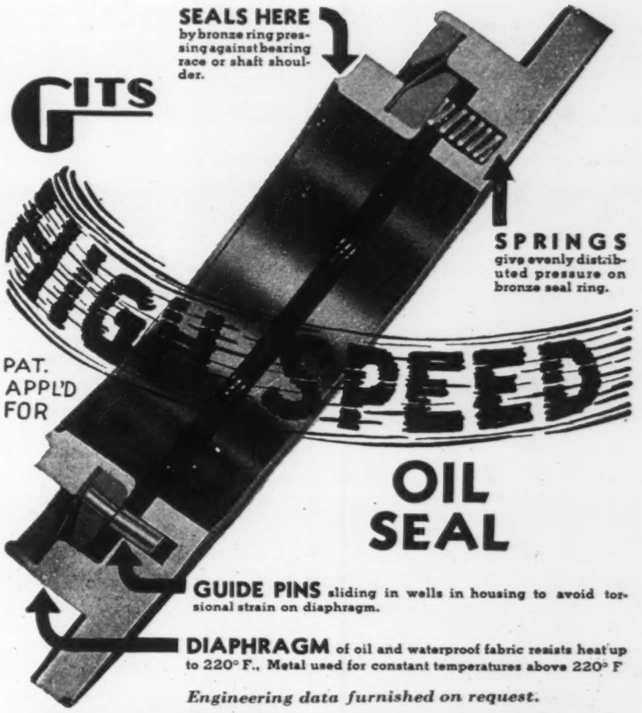
The annual index to MACHINE DESIGN for 1937 is available on request, and will be mailed without charge to readers desiring a copy. Address MACHINE DESIGN, Penton Building, Cleveland, Ohio.



GITS
SEALS HERE by bronze ring pressing against bearing race or shaft shoulder.
HIGH SPEED
SPRINGS give evenly distributed pressure on bronze seal ring.
PAT. APPL'D FOR
OIL SEAL
GUIDE PINS sliding in wells in housing to avoid torsional strain on diaphragm.
DIAPHRAGM of oil and waterproof fabric resists heat up to 220° F., Metal used for constant temperatures above 220° F

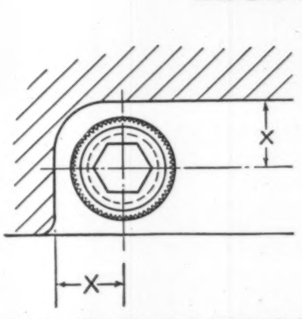
Engineering data furnished on request.

GITS BROS
MANU FACTURING CO.
1861 S. Kilbourn Ave., CHICAGO

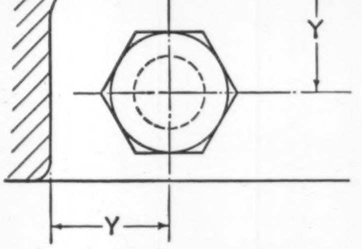
Here's a tip for YOU DESIGNERS

You can reduce the size of flanges by using UNBRAKO

KNURLED-SOCKET HEAD CAP SCREWS



See how the Knurled "Unbrako" snuggles right into the corner.



Notice the great open spaces necessary for the hex-head and wrench.

These illustrations show quite clearly how flange sizes can be cut down by using the "Unbrako" instead of the ordinary hex screw. The "Unbrako" snuggles right into the corner . . . there's no need to allow that extra space to get in a wrench. The savings in weight and cost of materials, as well as the improvement in design is obvious. The "Unbrako" has the knurled head that not only facilitates the work of putting it in place but further dresses up the product.

Send for a copy of our "Unbrako" Catalog which gives diagramatic views of this space saving as well as lots of other information.

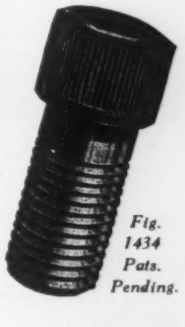


Fig. 1434 Pats. Pending.

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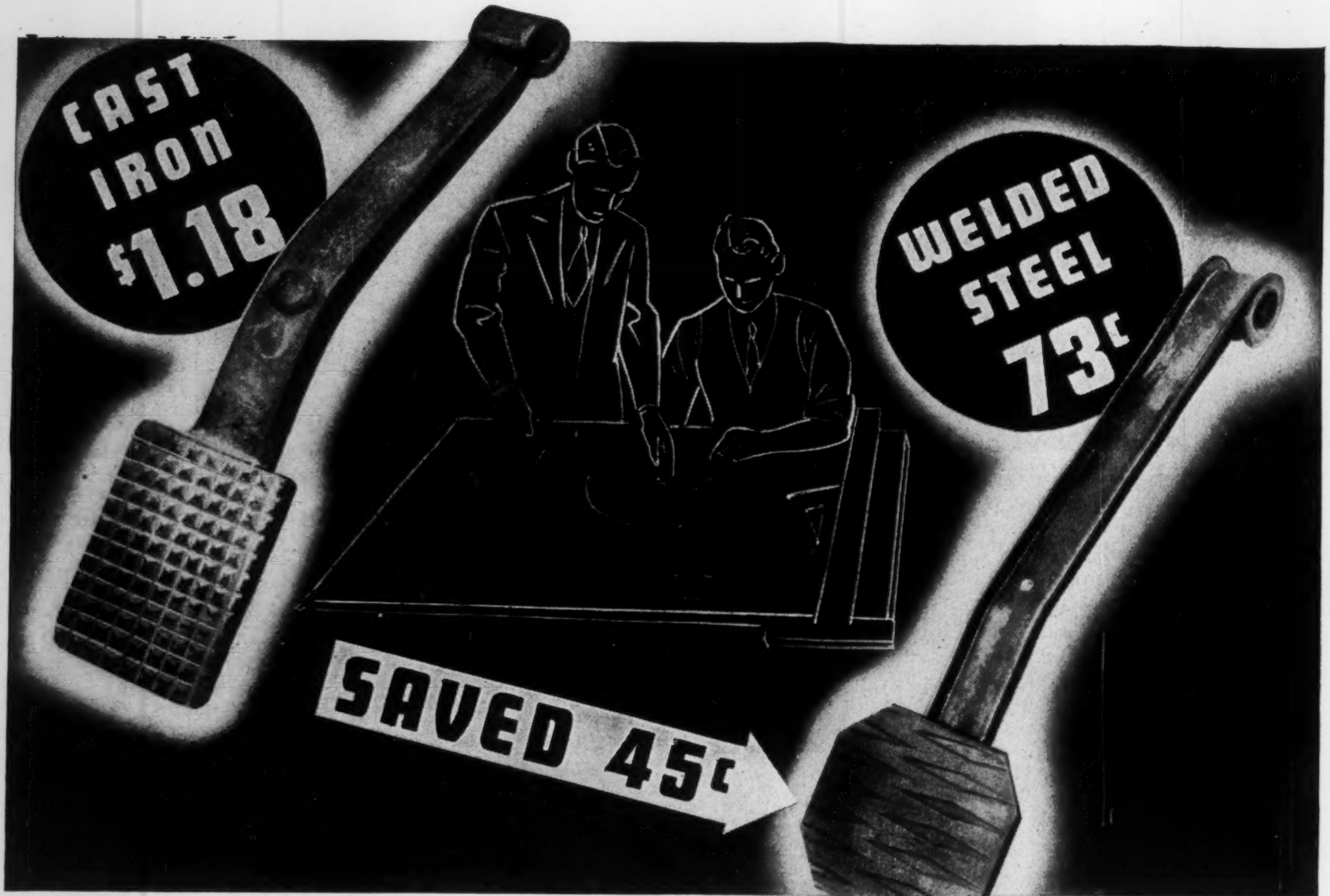

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